ENVIRONMENTAL IMPACT REPORT– SAN FRANCISCO AIRPORT EXPANSION

JANUARY 1973

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FOREWORD

Section 21151 of Division 13 of the State of California Public Resources Code states:

> "All local agencies shall prepare, or cause to be prepared by contract, and certify the completion of an environmental impact report on any project they intend to carry out or approve which may have a significant effect on the environment. When a report is required by Section 65402 of the Government Code, the environmental impact report may be submitted as a part of that report."

This report is submitted to comply with this requirement. Data used in this report were compiled from studies and reports listed in the bibliography. No original or basic data generation was made for this report.

The report is organized in accordance with the suggested outline prepared and issued by the Federal Aviation Administration and supplemented by the State of California laws.

SECTION ONE

Section 1

DESCRIPTION AND PURPOSE OF PROPOSED DEVELOPMENT

a. SUMMARY

San Francisco International Airport (SFO) proposes to expand its facilities to accommodate 31 million projected annual passengers by 1985 as contrasted with the 15.5 million annual passengers using the airport in 1972. The principal features of the expansion include new terminal buildings, remodeling of existing terminal buildings, additional roads, additional parking structures, apron and taxiway additions and modifications, and a number of support facilities.

Positive impacts of the airport expansion include the following:

1. Building facilities will be increased to accommodate the projected number of passengers.
2. Roads and parking facilities will be increased to accommodate the increased number of passengers and reduce traffic congestion.

   The air pollutants produced by automobiles on the airport should be less in 1985 than in 1972, even with the increased number of automobiles, because of more stringent auto emission standards.
3. The many building facilities are under the architectural review control of one firm so that the total development will be one architectural and visual whole.
4. The expanded facilities will allow more of the larger and quieter aircraft to use San Francisco International Airport.
5. The use of large aircraft will require greater spacing between aircraft before landing or after takeoff because of air turbulence and will probably limit the

airport to 310,000 annual airline operations. The use of the larger and quieter aircraft together with the limit on operations should reduce projected noise below 1972 levels.

6. The air pollutants produced by aircraft are expected to be less in 1985 as compared with 1972 due to the limit on aircraft operations and the conversion to newer, more efficient engines developed to reduce emissions.

7. Provision is being made in the expansion program for a Bay Area Rapid Transit (BART) station. If BART is extended to the Airport, it is expected to reduce the dependence of air passengers on the automobile and hence reduce air pollution.

8. The quality of water entering San Francisco Bay from the airport will be improved in 1985 over 1972 because an industrial wastewater treatment plant, and the construction of a deep water outfall.

The adverse impacts of the expansion program include the following:

1. More water, gas, electrical power, and aviation fuel consumption will be a secondary result.
2. More vehicle traffic will be expected at San Francisco Airport.
3. The construction and remodeling will cause some minor interferences with vehicle traffic and passenger movements.
4. Some fill in the Bay will be accomplished. An ongoing fill program is in progress under an existing Bay Conservation and Development Commission (BCDC) permit.
5. More solid waste will be generated.

The alternatives to the proposed expansion include:

1. Do nothing
2. Expand other airports
3. Construct a new airport

These alternatives were explored and expansion of San Francisco International Airport was the only feasible method of providing for increased passenger travel demands while minimizing environmental effects on the area.

The airport expansion is a major step in the development of the air transportation system in the Bay Area. The expansion envisions a larger average size of aircraft and a higher load factor than now exists; the result will be a more efficient system.

The expansion program will irretrievably commit money and materials to airport purposes.

b. DESCRIPTION

General

The Proposed Expansion Program is divided into two time phases:

- Phase I: That portion of the program that is either under construction now or has been completed already.
- Phase II: Those items for which detailed planning is underway and that can be accomplished between now and the end of 1981.

The program is further divided functionally into the Terminal, Airside, and Landside Areas. Brief descriptions and budgets for each subdivision are presented in the following paragraphs. A budget summary of the

projects and a more complete description of each can be found in Appendix A, together with a brief assessment of each individual project's impact.

Terminal Area

Figure 1-1 indicates the various terminal area projects by showing the project numbers on a Terminal Area layout. The Terminal Area consists of six project groups: North Terminal Complex, East Terminal Complex, South Terminal Complex, Terminal Support Facilities, Ground Transportation Complex, and Ground Transportation Support Facilities.

North Terminal Complex. The North Terminal Complex is an entirely new terminal facility consisting of a main terminal building with frontal gates along its entire length and three satellite boarding areas linked to the terminal by elevated connectors. A fourth, Boarding Area J, is sited for possible Phase III construction. Twenty-nine gate positions are presently provided in this complex.

The specific projects for the North Terminal Complex are:

• Phase I			
	T1	Demolition of Cargo Buildings	$ 300,000
	T2	North Terminal Foundations	4,000,000
• Phase II			
	T3	North Terminal Structure	28,000,000
	T4	Boarding Areas H and I and Connector	19,100,000
	T5	Boarding Area G and Connector	4,300,000
			$55,700,000

East Terminal Complex. The East Terminal Complex incorporates the former Central Terminal Building, new frontal gates extending north and south along the front of the present Northeast and Southeast Courts, and

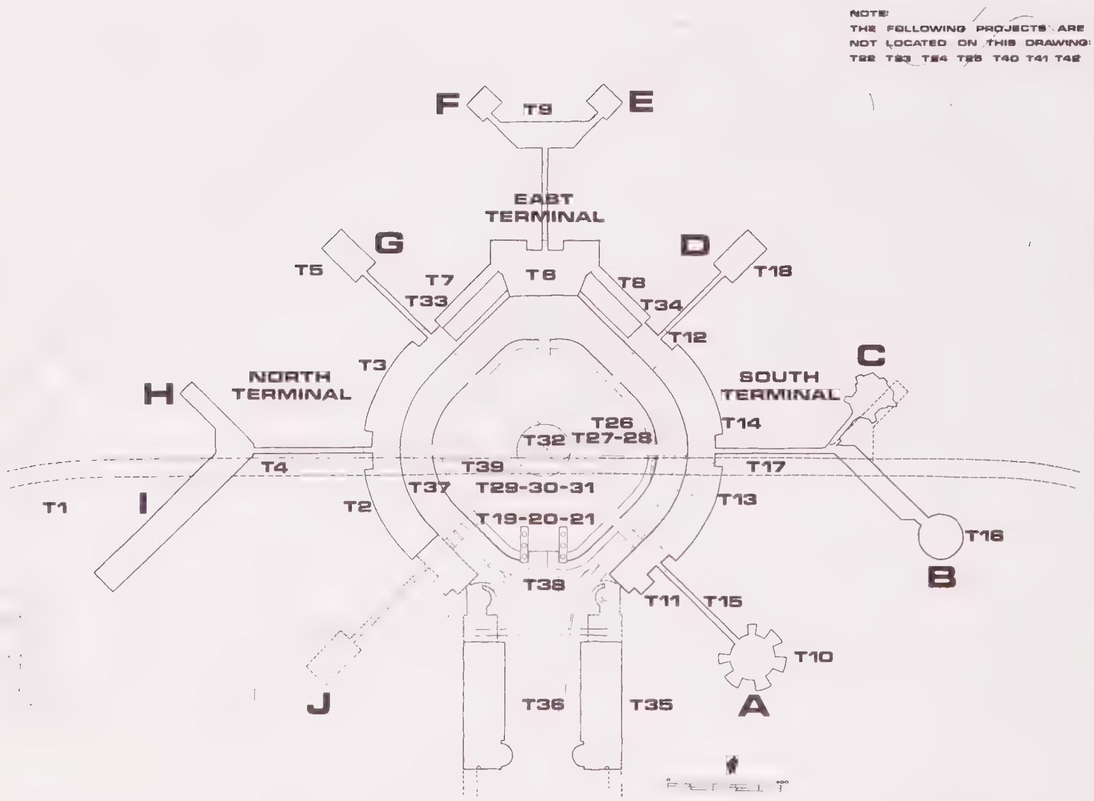

Figure 1-1. Terminal Area Projects

two satellite boarding areas linked to the terminal by one elevated connector. This complex provides 18 gate positions and has as specific projects:

- Phase II

T6	Existing Terminal Additions and Modifications	$12,800,000
T7	Northeast Frontal Gates	2,500,000
T8	Southeast Frontal Gates	2,700,000
T9	Boarding Areas E and F and Connector	7,500,000
		$25,500,000

<u>South Terminal Complex</u>. The South Terminal Complex is an enlargement and extension of the present South Terminal Building, providing frontal gates along its entire length plus four satellite boarding areas with three new elevated connectors. Three of these boarding areas, A, B, and D, are new; the fourth, Boarding Area C, is a redesignation of old Pier f. This complex will provide 33 gate positions. Specific projects are:

- Phase I

T10	Boarding Area A	$ 4,450,000

- Phase II

T11	South Terminal West Addition	9,200,000
T12	South Terminal East Addition	6,300,000
T13	Frontal Additions and Frontal Gates	8,500,000
T14	Modifications	10,700,000
T15	Connector A	2,300,000
T16	Boarding Area B	8,000,000
T17	Connector B-C	4,300,000
T18	Boarding Area D and Connector	4,600,000
		$58,350,000

<u>Terminal Support Facilities</u>. The Terminal Support Facilities consist of those projects required to make the Terminal Complexes fully functional. These projects are:

- Phase II

T19	Central Heating and Chilling Plant	$ 5,000,000
T20	Utility Distribution	1,000,000
T21	Interline Baggage Tunnel	2,800,000
T22	People Mover Systems (Terminal)	7,800,000
T23	Terminal Furniture	500,000
T24	Art Enrichment	2,000,000
T25	Demolition of Piers b, c, d, e, ff, g	1,250,000
		$20,350,000

Ground Transportation Complex. The Ground Transportation Complex lies in the center of the Terminal Area and contains those facilities needed for the transfer of passengers from the ground mode of transportation to the air mode, or vice versa. This complex will provide a five-level parking structure with a modern revenue-collection system, provisions for future additions of a BART subway and station, an underground tunnel for utilities and future interline baggage systems, a central water heating and chilling plant to supply the terminal air-conditioning systems, a 200-foot-diameter central open area, a 200-foot-high tower supporting a two-level observation deck and concession area below the cab on the new control tower recently approved by Congress, a Passenger Distribution Center at the sixth level, and radial structures from the central core to the various terminal buildings to support the People Mover System (PMS). This development contains the following specific projects:

- Phase I

T26	Fifth-Level Addition to Existing Garage	$ 1,967,000

- Phase II

T27	Existing Garage Additions and Modifications	5,600,000
T28	Existing Garage — PMS Structure	3,600,000
T29	Garage Addition	28,000,000
T30	Garage Addition — PMS Structure	500,000
T31	Passenger Distribution Center	8,100,000
T32	Control Tower and Ring	3,800,000
T33	Northeast Court Parking Deck	700,000
T34	Southeast Court Parking Deck	600,000
T35	Rental Car Facility	5,000,000
		$57,867,000

Ground Transportation Support Facilities. In addition to the foregoing, the Ground Transportation Support Facilities are required to make the Terminal Area a fully functioning facility. These are:

• Phase I			
	T36	Entry Roads and West Underpass	$ 3,008,000
	T37	Terminal Roads and East Underpass	10,904,000
• Phase II			
	T38	Upper Terminal Road Section	900,000
	T39	BART Access Provision	2,000,000
	T40	People Mover System (Garage)	14,500,000
	T41	Road Graphics	600,000
	T42	Grading, Irrigation, and Planting	850,000
			$32,762,000

The budget estimates for the People Mover System items (T22 and T40) are allowances incorporating the horizontal-elevator concept recommended by the San Francisco Airport Architects, even though the exact system selection has not been made.

Airside Area

The projects for Airside Area represent improvements to the runway and taxiway systems and the aprons to make the airport safer and more efficient to operate. They are depicted in Figure 1-2. The work includes runway extensions, high-speed exit taxiways, taxiway lighting, and aprons for the new gate locations. Specific projects are:

• Phase I			
	A1	Taxiway B and Apron	$ 2,755,000
	A2	Extension of Taxiway B and Apron	1,022,000
	A3	Taxiway G and L	624,000
	A4	South Terminal Apron Addition	881,000
	A5	Boarding Area A Apron	590,000
	A6	Taxiways D, E, F, G — Lighting	225,000
	A7	Taxiway B — Centerline Lighting	149,000
	A8	Remote Transmitter Facility	104,000

- Phase II

A9	Runway 1L Extension	230,000
A10	Runway 19L — High Speed Exit	600,000
A11	Runway Drains 19R and 19L	500,000
A12	Runway 28R Extension	2,900,000
A13	Runway 28R — High Speed Exit	550,000
A14	Runway Drains 28R and 28L	500,000
A15	Extend Taxiways A and B to 10R	1,500,000
A16	North Terminal Aprons	4,000,000
A17	East Terminal Aprons	3,250,000
A18	South Terminal Aprons	1,000,000
A19	Boarding Area B Apron	2,120,000
A20	Noise Monitoring Program	500,000
		$24,000,000

All but two of the Airside projects included in the revised expansion program were denoted as high priority by Peat, Marwick, and Mitchell's recent study, Analysis of Airfield Improvements at San Francisco International Airport, which was submitted in preliminary form in April of 1972. The other two, Projects A10 and A15, were both given moderate priority ratings. Project A10, Runway 19L High-Speed Exit, is included because this runway receives 90 percent of the landings on Runways 19R and 19L, most of which occur during the rainy winter months. Present Taxiway G is the only exit available for large jets, but is too close to the runway threshold to be of much use for the higher speed, turbulent-air landings or wet-pavement landings. Project A15, Taxiways A and B extension to Runway 10R, is a development that can be logically and economically incorporated into the development of taxiways and aprons for the North Terminal Complex.

Landside Area

Figure 1-3 shows the Landside Area and locates the projects included in the Proposed Expansion Program. These projects provide for facilities needed to support the activities of the airport, and consist of two groups: Landside Facilities and Airport Service Facilities. Specific items are:

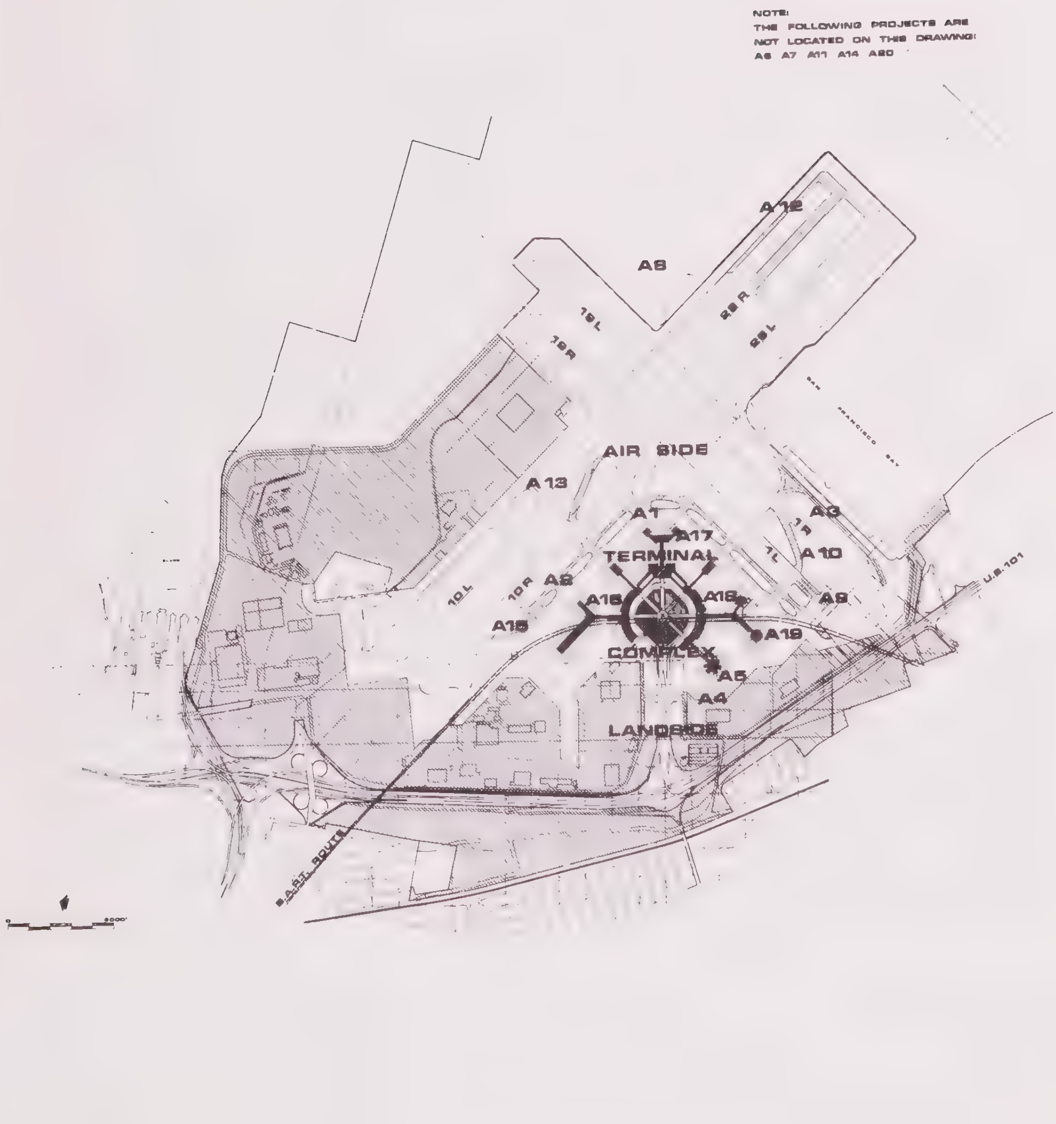

Figure 1-2. Airside Area Projects

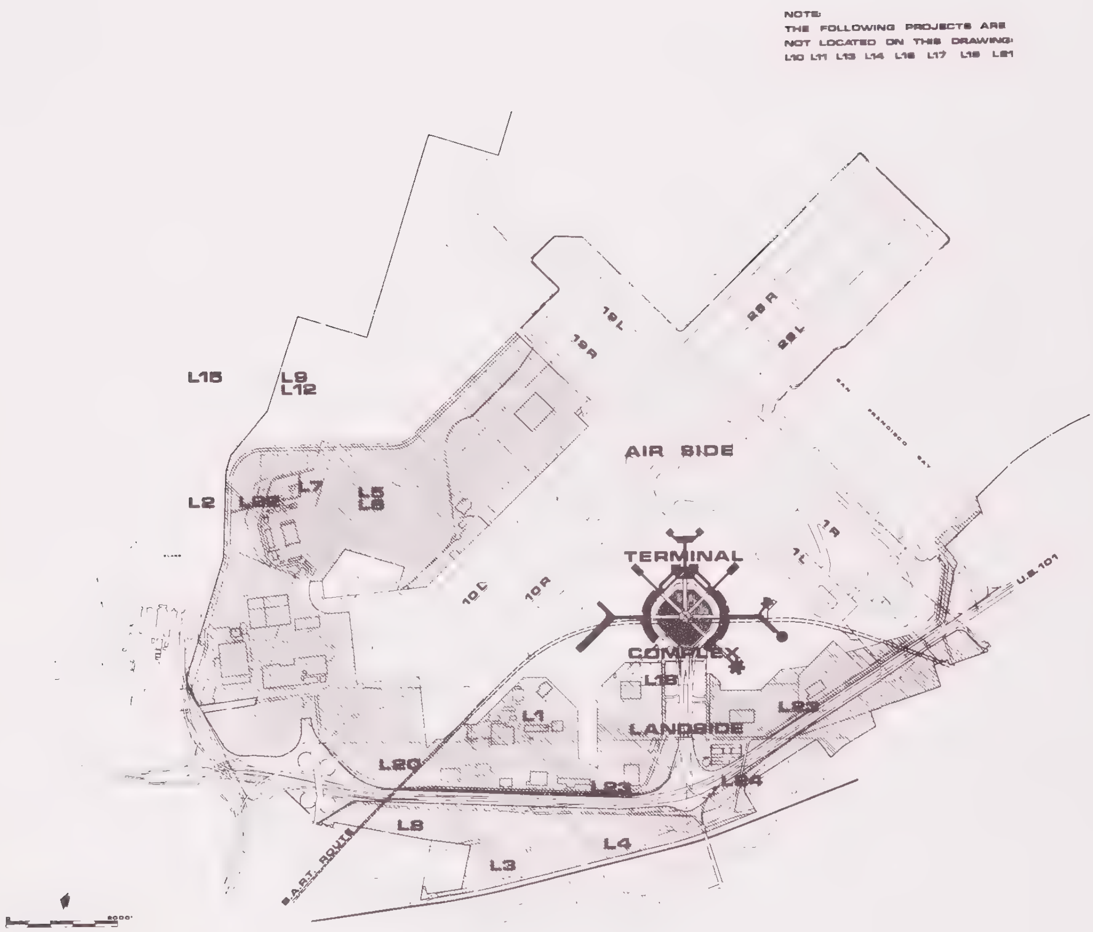

Figure 1-3. Landside Area Projects

• Landside Facilities

•• Phase I			
	L1	Cargo Building No. 7	$ 387,000
	L2	North Airport Fill	2,464,000
	L3	West of Bayshore Fill	1,805,000
•• Phase II			
	L4	West of Bayshore Utilities and Roads	1,300,000
	L5	Seaplane Harbor Fill	10,000,000
	L6	Seaplane Harbor Utilities and Roads	2,500,000
	L7	Relocate Standard Oil Hangar	900,000

• Airport Service Facilities

•• Phase I			
	L8	West of Bayshore Power Substation	357,000
	L9	Sewage Treatment Plant	2,410,000
	L10	Influent and Effluent Lines to Sewage Treatment Plant	460,000
	L11	Utilities to Sewage Treatment Plant	233,000
•• Phase II			
	L12	Sewage Treatment Plant Standby Power	525,000
	L13	Deep Water Outfall	500,000
	L14	Replace Present Sanitary Sewers	700,000
	L15	Industrial Waste Plant	2,500,000
	L16	Industrial Waste Force Mains	1,000,000
	L17	Industrial Waste Pump Stations	500,000
	L18	Administration Building	5,000,000
	L19	Automatic Control System	5,000,000
	L20	Airport Maintenance Facility	1,500,000
	L21	Fire-Crash Building	500,000
	L22	North Access Road	230,000
	L23	Widen Frontage Road to Four Lanes	2,500,000
	L24	Overpass to West of Bayshore (Funded by State Highways Department)	—
			$43,271,000

c. PURPOSE

The purpose of the expansion program is to provide the airport facilities necessary to accommodate 31 million annual passengers expected by 1985.

The Association of Bay Area Governments (ABAG) forecasted 72 million annual passengers in 1985 for all airports in the San Francisco Bay Area[1]. ABAG conducted a series of studies on how best to develop the airports in the Bay Area to accommodate the forecasted increases in air passengers. Eleven possible alternatives or combinations of alternatives were studied. The final recommendation concerning San Francisco International Airport was that it should be developed to its maximum capacity.

d. ENVIRONMENTAL CONTROLS DURING CONSTRUCTION — PROPOSED METHOD OF ACCOMPLISHMENT

The major construction activities for the new terminal facilities where environmental quality may be a problem will include changing the existing

[1] W. E. Gillfillan, Regional Airport Systems Study Final Plan Recommendation, ABAG, June 1972

terrain for automobile parking and aircraft parking; installing crushed rock under areas to be paved with asphalt; paving with asphalt; paving with Portland cement concrete in certain aircraft parking areas; and construction of the terminal buildings.

The construction materials for these activities will be obtained from existing suppliers, quarries, and asphalt plants in the area. The contractors will be required to operate in accordance with existing pollution control methods. Provisions will be included in the construction specifications to ascertain that the criteria for environmental controls during construction are met. Recommendations from Federal Aviation Agency (FAA) Advisory Circular AC 5370-7, Airport Construction Controls to Prevent Air and Water Pollution, will be included. The contractor will be required to maintain all excavations, embankments, haul roads, access roads, plant sites, waste disposal areas, borrow areas, and all other work areas within or without the project limits free from dust that would cause a hazard to the work or to persons or property.

Construction access will be by existing public roads. Large trucks and heavy construction equipment will be prohibited from using the main access road unless there is no other feasible route.

The emission of smoke, dust, or other air pollutants from asphalt plants, rock quarries, concrete plants, and other construction equipment is under the control of the Bay Area Air Pollution Control District, which issues permits for such equipment when the equipment is in conformance with their requirements.

Noise will be generated by construction of the airport expansion. The major portion of the expansion is east of the Bayshore Freeway, approximately 3,000 feet from residential areas. Freeway traffic and aircraft

Interline Baggage Equipment
North Terminal, West Extension, and Addition of Boarding Area J
Replacement of Pier f

- Airside
  Extend Taxiway L to Runway 19L
  Extend Runway 19R
  New Runway for Light Aircraft
  Taxiway for New Runway

- Landside
  West of Bayshore — Part 2
  North Area Development

Projects in Phase III are not a part of the impact statement.

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Noise will be generated by construction of the airport expansion. The major portion of the expansion is east of the Bayshore Freeway, approximately 3,000 feet from residential areas. Freeway traffic and aircraft

operations have effectively "masked" any construction noise in this area in the past. Construction in the airport property west of the Bayshore Freeway was primarily fill and the installation of utilities. Construction work is normally accomplished during daytime hours from 7:00 A.M. to 4:30 P.M. Construction work in the evening or night is done only for emergencies or to eliminate operational problems.

Water that has to be pumped out of any construction area is routed to the existing storm drain system. The storm drain system has two detention basins where solids and large contaminants are settled out before the water is discharged to the bay.

Waste materials from construction will be disposed of as legally required. Raw sewage will be disposed of at the sewage treatment plant.

e. COMMUNITIES NEAR THE AIRPORT

San Francisco International Airport is owned and operated by the City and County of San Francisco. The airport is physically located in San Mateo County. The cities adjacent to or near the airport are shown in Figure 1-4.

The airport has an effect far beyond the communities immediately adjacent to the airport. The section of the report describing noise provides one parameter for describing boundaries of the area that may be significantly affected by the proposed development.

Another parameter is the counties that are served by San Francisco International Airport. These include:

- Alameda
- Contra Costa

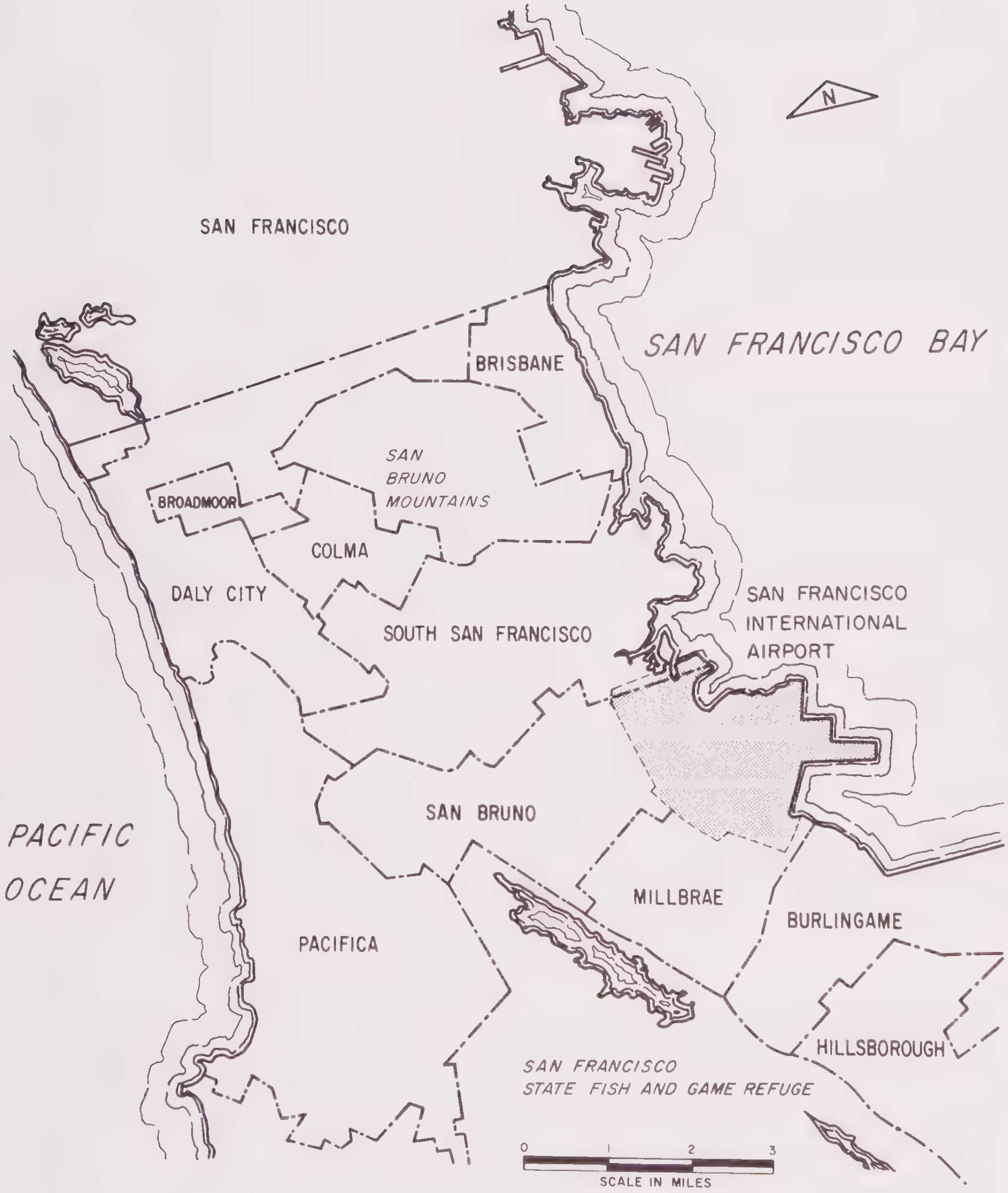

Figure 1-4. Cities Adjacent to San Francisco International Airport

- Marin
- San Francisco
- San Mateo
- Santa Clara

The following counties are served by San Francisco International Airport to a lesser extent:

- Napa
- Solano
- Sonoma

f. ENVIRONMENTAL DESCRIPTION

San Francisco International Airport ranks high nationally in the number of passengers carried and the number of air carrier operations performed. For instance, in 1969 San Francisco ranked fifth with 13,969,000 total passengers and 306,929 air carrier operations. Only Atlanta, John F. Kennedy, Chicago O'Hare, and Los Angeles International airports exceeded these figures. In 1972, San Francisco had over 15,600,000 passengers and again ranked fifth nationally.

The airport is located in the midst of a large population area. The airport serves the population of the following counties:

County	1970 Population
Alameda	1,073,184
Contra Costa	555,805
Marin	206,758
San Francisco	715,674
San Mateo	556,601
Santa Clara	1,066,421
Total	4,174,443

To a lesser extent, the airport serves the population of the following counties:

County	1970 Population
Napa	79,140
Solano	171,815
Sonoma	204,885
Total	455,840

San Francisco International Airport is located with San Francisco Bay on the east side of the airport and the following communities near the other sides of the airport.

Community	1970 Population
Brisbane	3,003
Burlingame	27,320
Daly City	66,922
Foster City	9,522
Hillsborough	8,753
Millbrae	20,920
San Bruno	36,254
San Mateo	78,991
South San Francisco	46,646

As indicated above, San Francisco International is a major existing airport in a large urban area and serves a major air transportation need. The existing environment is described in detail and compared with the expected 1985 conditions in the following section.

The airport expansion program takes place within the existing airport boundaries. Existing functions will grow or change, but no new conditions are expected to be imposed on the environment. The expansion program is part of an ongoing program that was formulated in 1967, of which some portions have already been completed, as indicated in Appendix A.

Section 2

PROBABLE IMPACT OF THE PROJECT ON THE HUMAN AND NATURAL ENVIRONMENT

San Francisco International Airport began operations in 1927 with a 1,700-ft graded dirt landing strip on 155 acres of leased land. During the next 45 years, the City and County of San Francisco and the airport tenants invested over $200 million to meet the ever-growing needs of air transportation.

This report describes the impacts that the proposed development will create over and above the existing development. It does not attempt to assess the impact as if the airport had never existed.

The report describes the existing and projected 1985 conditions for each aspect of the environment. Because of data collection problems, the "existing" year may vary between 1965 and 1972, depending on the aspect being considered and the data available.

The expansion program involves a considerable number of projects. Each project by itself may have relatively little impact, but the combined total of projects into a complete system will have a measurable overall impact. These projects can be viewed as synergistic; the total system impact is greater than the sum of each individual project's impact.

A brief paragraph description of each project together with a paragraph summary of the environmental impact of each individual project is given in Appendix A.

a. IS THE DEVELOPMENT CONTROVERSIAL?

The proposed San Francisco International Airport development program has not been opposed to date. The program has been adopted and integrated into the Regional Airport Systems Study and is the Airport Element in the Bay area Regional Plan 1970-1990 prepared by the Association of Bay Area Governments.

The development monies involve over $390 million. Several groups or individuals suggest that this money be spent in other areas for the betterment of society. This money is available mainly through revenue bonds and the entire amount will be paid for by the users of the airport; hence the money would not be available for other purposes.

Public hearings and letters received on the Regional Airport Systems Study indicate the following classes of comments:

- No airport expansion favored. Increased passengers would be accommodated by higher load factors on aircraft, revised flight schedules, or alternate means of transportation.
- Any filling of the Bay for airport expansion was opposed by some people for aesthetic reasons.
- The small percentage of the population who are airplane passengers was pointed out.
- Some comments were received from people who indicated that they would be willing to choose reduced service for environmental reasons.

A summary of the public hearings is contained in Appendix B.

The development will create changes in the environment. To obtain the public's response to the development of airports in the Bay Area, 30,000

copies of a newspaper, Aviation Future, containing a questionnaire were distributed in 1971.

Eight hundred and fifty-one people returned the questionnaire. The questionnaire and an analysis of the responses are given in Appendix C.

Questionnaire respondents were asked to rank environmental issues in order of their estimated importance. The ranking is given in Table 2-1, with 1 being most important and 6 the least important.

Table 2-1

RANKING OF RESPONSES TO ENVIRONMENTAL QUESTIONNAIRE

Issue	1	2	3	4	5	6	7	Unusable
Air quality	413	215	96	46	34	22	0	25
Bay preservation	105	172	195	187	92	68	2	30
Noise	163	182	164	97	89	136	0	20
Plant life	54	49	120	194	254	148	0	32
Population level	230	122	132	119	81	139	0	28
Wild animal life	56	64	85	139	219	254	0	34
Other	1	1	0	0	0	0	1	0

Table 2-1 indicates that the respondents were most concerned with air quality, and population level, noise, and Bay preservation were not far behind.

b. WILL THE DEVELOPMENT NOTICEABLY AFFECT AMBIENT NOISE LEVEL FOR A SIGNIFICANT NUMBER OF PEOPLE?[2]

Noise from current operations at San Francisco International Airport is an environmental factor of concern to many citizens. The question of

[2] Most of this section is excerpted from Aviation Noise Evaluations and Projections, San Francisco Bay Region, Bolt Beranek and Newman, August 1971

expansion of the facilities, therefore, introduces concern about the changes in noise environment that would accompany the airport expansion. This phase of the environmental impact study is concerned with defining, in as quantitative a manner as possible, the changes in noise environment for the proposed expansion as compared to the current noise exposure.

Since the introduction of high-power military jet aircraft in the early 1950's and the widespread introduction of commercial jet aircraft in the early 1960's, considerable study has been devoted to the measurement of aircraft noise and the interpretation of aircraft noise with respect to its effect on people, both as individuals and as groups living in communities near airports. From these studies, various measures have evolved for relating the noise of single events, such as an aircraft flyover, to individual response, and various methods have been developed for estimating community response to the noise environment created by aircraft operations occurring over an extended period of time. Two types of noise descriptors are used in describing aircraft noise:

- Descriptors concerned with measurements of single events such as the noise generated by an aircraft takeoff, landing, or a ground runup operation. These are of practical interest in comparing one event with another, or in comparing the noise produced by different aircraft.
- Descriptors concerned with summarizing the noise exposure resulting from many individual noise events of different levels and time patterns occurring over a considerable time period. These are of particular interest in comparing the noise exposure existing at different positions around the airport, or in comparing the effect of changes in airport configurations or operations.

Of major concern at San Francisco International Airport is the noise produced by jet aircraft during takeoff and landing operations.

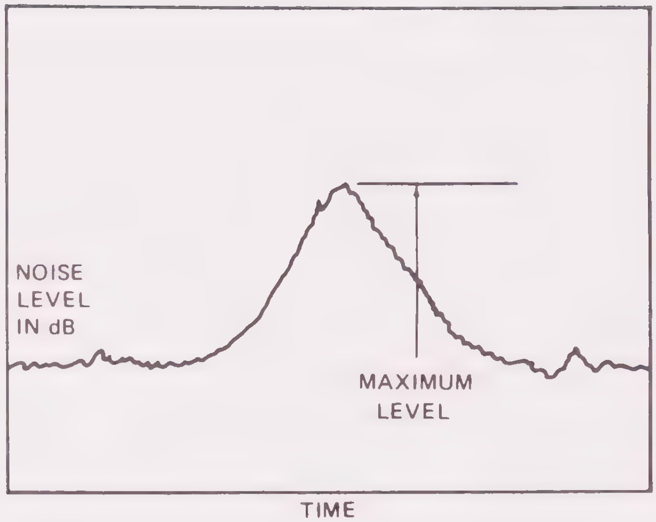

Figure 2-1. Aircraft Noise Level versus Time

As shown in Figure 2-1, a typical flyover noise signal can be characterized in time as a "haystack" shaped signal that emerges from a lower ambient noise level and increases to a maximum over a period of seconds and then decreases to merge once more with the background noise. The flyover signal can be described in terms of either the maximum noise level reached during the flyover or in terms of the integration of the noise signal over time (i.e., include the effects of signal duration as well as maximum level).

Studies over the last few years have resulted in the development of several meaningful scales, of varying complexities and accuracy, for measuring aircraft noise. These studies were prompted by the fact that many direct and simple measurements of aircraft noise showed relatively poor correlation with people's subjective assessments of aircraft sounds. As an example, if one measures aircraft noise in terms of the

overall sound pressure level using a sound level meter, one will find the same overall sound pressure level reading for a flyover by a jet aircraft and a piston-powered propeller aircraft. However, the jet aircraft would sound much noisier (or less acceptable) to the average observer than the flyover sound of a piston-powered propeller aircraft. The major reason for this discrepancy between measurement and human response is that the human ear does not respond equally well to sound of all frequencies but is less efficient at low and high frequencies than at medium or speech-range frequencies. Thus, to obtain a single number measure of the sound pressure level of a noise that may contain a wide range of frequencies in a manner approximating that of the ear, it is necessary to reduce, or weight, the low and high frequencies with respect to the medium frequencies.

Various noise exposure methods have been developed to describe the noise exposure resulting from repeated single events. All the procedures include some common elements that are vital in describing the noise impact in land areas surrounding an airport. These elements are:

- Evaluations of the noise level of individual events that are well correlated with people's response in terms of loudness, noisiness, or acceptability, or that can be related to speech interference effects.
- Adjustments for the relative duration of noise intrusions and the number of noise events occurring within a given time period.
- Weighting factors for daytime and nighttime (or daytime, evening, and night periods). Such weighting factors are particularly important in relating noise exposure to response in residential areas because of the increased sensitivity of people to noise intrusions during leisure and sleeping hours.

The effect of the adjustments and weighting factors is to expand the size of a given noise exposure contour as the noise levels increase, or as the number of operations increase, or as the proportion of night operations increase.

Currently three measures for describing the noise environment in the vicinity of airports are in use within the State of California. Listed in order of historical development, the three measures are:

- Composite Noise Rating (CNR)
- Noise Exposure Forecast (NEF)
- Community Noise Equivalent Level (CNEL)

The Noise Exposure Forecast procedures used in this report are a refinement of the earlier CNR procedures[3] widely used in this country by the FAA and Department of Defense for airport and land-use planning. The NEF procedures have been applied to define the noise exposure around a number of U.S. airports[4].

The CNEL is employed in the airport noise standards by the State of California and has been developed basically for noise surveillance to define noise impact areas around airports and to determine compliance with noise limits[5]. Table 2-2 presents a summary comparison of the factors utilized in the three noise environment measures. The Bishop-Simpson report[4] gives further comparisons of NEF, CNR, and CNEL values to facilitate conversions from one measure to another.

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[3] Galloway, W. J., and Pietrasanta, A. C., Land Use Planning Relating to Aircraft Noise, Technical Report No. 821, Bolt Beranek and Newman Inc., published by the FAA, October 1964. Also published by the Department of Defense as AFM 86-5, TM 5-365, NAVDOCKS P-98, Land Use Planning with Respect to Aircraft Noise.

[4] Bishop, D. E., and Simpson, M. A., Noise Exposure Forecast Contours for 1967, 1970, and 1975 Operations at Selected Airports, FAA Report FAA-NO-70-8, 1970

[5] Section 21669 Public Utilities Code, State of California

Table 2-2

COMPARISON OF FACTORS CONSIDERED IN NOISE ENVIRONMENT MEASURES

Noise Environment Measure	Basic Noise Measure	Adjustment For Number Of Operations	Weighting For Time Of Day
CNR	PNL	10 log n (modified)[a]	Night Weighting
NEF	EPNL	10 log n	Night Weighting
CNEL	SENEL	10 log n	Evening And Night Weightings

[a]Employs adjustments in 5-unit steps.

The Noise Exposure Forecast (NEF) value at a ground position provides an estimate of the integrated noise exposure resulting from aircraft operations. The NEF values are calculated from:

- Measures of the aircraft flyover noise described in terms of the Effective Perceived Noise Level (EPNL).
- The average number of flyovers per day (0700 to 2000 hours) and per night (2200 to 0700 hours).

In calculation, it is convenient to group the aircraft in classes by consideration of the aircraft noise characteristics and takeoff and landing performance. Each class is assigned a description of the noise in terms of a set of EPNL versus distance curves and a set of takeoff and landing profiles. Thus, for a given class of aircraft at a particular power setting (i.e., takeoff power), it is assumed that the aircraft noise characteristics can be described by a single EPNL-versus-distance curve.

The total noise exposure at a given point produced by aircraft operations is viewed as being composed of the effective perceived noise levels produced by the number of operations of each different aircraft class flying along different flight paths.

The civil aircraft noise and profile information utilized in the construction of the NEF contours is summarized in the Bishop-Simpson report[6]. Information is given for 12 major civil aircraft classes that include current and future commercial jet aircraft to 1985, with the exception of possible SST aircraft. Noise information for current aircraft is based on measurements from a variety of sources, and includes data from both formal aircraft noise tests and measurements at civil airports during routine airport operations.

Noise and performance projections for future aircraft are based on industry estimates and the assumption that by 1985 all types of older aircraft (in service in 1970-71) will have been modified to meet current (1971) FAA noise certification requirements for newer aircraft under Federal Aviation Regulation (FAR) 36.

FAA noise certification requirements[7] do not define specific aircraft performance and noise characteristics; thus, some arbitrary assumptions must be made as to the means by which aircraft will meet FAR 36 standards. For this study, it was assumed that takeoff and landing profiles

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[6] Bishop and Simpson, op. cit.

[7] The FAR 36 standards set aircraft noise level limits at three positions for maximum gross-weight conditions and for a single set of "acoustic reference" weather conditions (77°F, relative humidity of 70 percent, and zero wind). The three positions are: (a) under the takeoff flight path at 3.5 nautical miles from start to takeoff roll; (b) to the side of takeoff path at 0.25 (or 0.35) nautical miles at the point of maximum noise level; (c) under the approach path, at 1 nautical mile from the runway threshold. The standards permit a power cutback before reaching the takeoff noise measurement position.

would be unchanged, with noise characteristics alone modified to meet FAR 36 requirements. It was further assumed that the modifications would be the minimum to meet FAR 36 requirements. While this is a conservative (i.e., pessimistic) assumption, it more realistically reflects what may happen with engine retrofit programs. It was therefore assumed that aircraft will meet FAR 36 takeoff requirements (3.5 nautical miles from start of takeoff roll) by a noise abatement procedure involving a reduction of thrust and in climb gradient before reaching the 3.5-nautical-mile point. However, since there is no requirement that such special noise abatement procedures be used in actual service, power cutback procedures and profiles were not assumed in computing the NEF contours for the San Francisco International Airport. If the cutback were utilized, a reduction of about 13 EPNdB would be effected for four-engine jet aircraft and significantly smaller NEF contours for takeoff flight paths would result.

Reductions of approach noise of approximately 6 to 11 EPNdB have been assumed to meet FAR 36 approach requirements, and a reduction of approximately 2 EPNdB in noise levels at takeoff thrust have been assumed to meet FAR 36 "sideline" requirements.

The estimates of the "total" noise exposure resulting from aircraft operations, expressed as NEF values, can be interpreted in terms of probable impact on land uses using the guides summarized in this section of the report. These guides[8] are based on the following major considerations.

- Accumulated case history experiences of noise complaints near civil and military airports
- Speech interference criteria

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[8] Adopted from: Galloway, W. J., and Bishop, D. E., Noise Exposure Forecasts: Evolution, Evaluation, Extensions and Land Use Interpretations, FAA-NO-70-9, 1970

- Subjective judgment tests of noise acceptability and relative "noisiness"
- Need for freedom from noise intrusions
- Typical noise insulation provided by common types of building construction

Different considerations are given precedence for the differing land uses. For example, in determining the effects of noise on residential land use, case history experience, annoyance judgments, and speech communication criteria are most important; for concert halls, the need for freedom from noise intrusion is probably most important.

Table 2-3 presents the interpretations of land use compatibility with respect to NEF values for generalized land uses – residential and educational, commercial, industrial, and agricultural (or open). In Table 2-3, the compatibility interpretation for the lowest NEF values has the notation "satisfactory, with... no special noise insulation requirements for new construction", indicating that there should be no adverse effects from aircraft noise. The interpretations at higher levels of noise exposure generally define a range in which new construction or development should not be undertaken unless needed noise insulation features are included in the building design and site development. For more extreme noise exposure, many of the land uses are assigned an interpretation stating new construction or development should not be undertaken.

Each of the four generalized land uses encompasses a rather wide range of human activities having varying sensitivities to noise intrusions. Hence, the interpretations of Table 2-3 should be taken as guides, not as absolute criteria to be blindly applied to all activities or sites falling into one of the classifications. In application to a specific site, some

Table 2-3

NOISE COMPATIBILITY INTERPRETATION

Generalized Land Use	NEF Range	General Land Use Recommendation
Residential and Educational	Less than 30	Satisfactory, with little noise impact and requiring no special noise insulation requirements for new construction.
	30 to 35	New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation features included in the design.
	Greater than 35	New construction or development should not be undertaken.
Commercial	Less than 35	Satisfactory, with little noise impact and requiring no special noise insulation requirements for new construction.
	35 to 45	New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation features included in the design.
	Greater than 45	New construction or development should not be undertaken unless related to airport activities or services. Conventional construction will generally be inadequate and special noise insulation features should be included in construction.
Industrial	Less than 40	Satisfactory, with little noise impact and requiring no special noise insulation requirements for new construction.
	40 to 50	New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation features included in the design.
Generalized Land Use	NEF Range	General Land Use Recommendation
	Greater than 50	New construction or development should not be undertaken unless related to airport activities or services. Conventional construction will generally be inadequate and special noise insulation features should be included in construction.
Open	Less than 40	Satisfactory, with little noise impact and requiring no special noise insulation requirements for new construction.
	Greater than 40	Land uses involving concentrations of people (spectator sports and some recreational facilities) or of animals (livestock farming and animal breeding) should generally be avoided.

Source: Bolt, Beranek and Newman, Aviation Noise Evaluations and Projections, San Francisco Bay Region, August 1971.

adjustments in boundaries or interpretations may be desirable. Typical influences to consider include:

- Previous community experience and previous complaint history in the immediate neighborhood
- Influence of the existing noise environment due to industrial or surface transportation noise sources. For example, the introduction of aircraft noise in a rural area where existing background noise levels are very low would produce a much more apparent change in noise environment, and likely more pronounced reaction from residents, than would aircraft noise introduced in a dense urban area long exposed to traffic noise
- Time period of land-use activities. The basic NEF values consider both daytime and nighttime operations, with a heavy weighting factor applied for nighttime operation. Such considerations are particularly appropriate for residential land considerations but may lead to overestimation of NEF values for activities that are confined to daytime hours only.

The NEF values for land-use compatibility in Table 2-3 are based on the type of building construction that would normally be used where aircraft noise is of no concern. Thus, the land-use compatibility ratings for schools assume building construction involving single glazing of classroom windows. Special noise consideration incorporating double glazing or elimination of windows entirely has not been made. Obviously, for many buildings, added noise insulation can be provided during construction. Procedures and data for determining the degree of noise insulation and the specific construction features required in a building are discussed elsewhere.[9, 10]

[9] Bishop, D. E., A Study-Insulating Houses from Aircraft Noise, U. S. Department of Housing and Urban Development, November 1966. Available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; $0.55

[10] Berendt, R. D., Winzer, G. E., Burroughs, C. B., A Guide to Airborne, Impact and Structure Borne Noise-Control in Multi-family Dwellings, U. S. Department of Housing and Urban Development, September 1967. Available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; $2.50

The depiction of noise exposure by contours has limitations, since many variables may affect the noise levels heard on the ground during large numbers of aircraft operations. Careful observation will show that two aircraft even of the same class rarely follow exactly the same path with respect to ground track or altitude profiles. Differences may arise due to pilot techniques, temperatures, winds, and aircraft load.

Noise propagation through the atmosphere may also change from day to day and hour to hour due to differences in relative humidity, temperature, and winds. For an aircraft in flight, noise propagation to the ground is somewhat dependent on temperature and humidity but is relatively little influenced by winds. For ground operations, however, winds may be very important in determining the sound levels at a distant position. Noise levels actually heard on the ground are also affected by the terrain and by reflections or shielding from nearby hills, buildings, or other obstacles. Such terrain effects are usually small from noise propagated from aircraft in the air, and are most important for propagation along the ground.

Changes in elevation under the flight path have been taken into account in calculating the NEF contours for departures on Runway 28 at SFO.

Because of the variables discussed above, the accuracy of NEF contours generally decreases as distance from the airport increases due to the greater variability in aircraft paths and sound propagation at large slant distances.

The daily numbers of operations at San Francisco International Airport are given in Tables 2-4 and 2-5 for 1970 and 1985, respectively. The volume of operations for 1970 is based on that existing between April 1969 and March 1970 as given in the Bay Area Study of Aviation Requirements (BASAR) Airport and Airspace Capacity Analysis report and Section C of ABAG Technical Memorandum II-1. The 380,000 annual airline

Table 2-4

DAILY NUMBER OF OPERATIONS AT SAN FRANCISCO INTERNATIONAL AIRPORT — 1970

Aircraft Type		Takeoffs — Stage Length In Nautical Miles				
		Landings	0-500	501-1000	1001-1500	1501-2500
4-Engine Turbojet	Day	52.682	13.035	6.517	2.172	27.156
	Night	11.948	5.431	2.172		8.147
4-Engine Turbofan	Day	83.639	18.466	15.207	13.035	42.363
	Night	24.440	4.888	2.172	1.086	10.862
4-Engine "Stretch Fan"	Day	8.690	1.086			7.604
	Night	5.431			1.086	4.345
3-Engine Turbofan	Day	31.500	13.035	9.776	7.604	4.345
	Night	8.690	1.086	2.172	1.082	1.086
3-Engine "Stretch Fan"	Day	55.397	43.449	5.431	6.517	1.086
	Night	1.086				
2-Engine Turbofan	Day	87.442	77.666	9.776		
	Night	2.172	2.172			
4-Engine HBPR[a] Fan	Day	8.690				8.690
	Night	1.086				1.086
General Aviation Jet	Day	4.345	4.345			
	Night					
2-Engine Prop > 12,500 lb	Day	26.070	27.156			
	Night	1.086				
2-Engine Prop < 12,500 lb	Day	41.277	39.104			
	Night	1.086	3.259			

[a]HBPR = High Bypass Proportion Ratio

Table 2-5

DAILY NUMBER OF OPERATIONS AT SAN FRANCISCO INTERNATIONAL AIRPORT — 1985

Aircraft Type		Takeoffs — Stage Length In Nautical Miles				
		Landings	0-500	501-1000	1001-1500	1501-2500
4-Engine-Turbofan	Day	58.904	13.005	10.710	9.180	29.834
	Night	17.213	3.443	1.530	0.765	7.650
4-Engine "Stretch Fan"	Day	12.881	1.610			11.271
	Night	8.051			1.610	6.441
3-Engine Turbofan	Day	14.915	6.172	4.629	3.600	2.057
	Night	4.116	0.515	1.028	0.515	0.515
3-Engine "Stretch Fan"	Day	96.581	75.749	9.468	11.363	1.894
	Night	1.894				
2-Engine Turbofan	Day	39.134	34.758	4.375		
	Night	0.971	0.972			
4-Engine HBPR[a] Fan	Day	71.998	39.624	9.799	8.457	16.178
	Night	12.012	3.213	1.235	0.940	4.564
2, 3-Engine HBPR Fan	Day	158.997	87.505	21.640	18.678	35.727
	Night	25.620	7.095	1.820	2.075	10.077

[a]HBPR = High Bypass Proportion Ratio

operations for 1985 is based on the maximum airport capacity for the existing runway configuration as given in the BASAR Airport and Airspace Capacity Analysis report. These figures were based on a calculated airport capacity before the effects of air turbulence created by large jets were known. The airport capacity figure has been reduced to an estimated value of 310,000 annual airline operations.

Flight path tracks for Instrument Flight Rules (IFR) traffic are based on study of standard instrument departure routes. (At some airports, actual instrument departure tracks may show considerable variation from those inferred solely from standard instrument departure procedures.) Information was obtained from airport and tower personnel to define Visual Flight Rules (VFR) flight paths. Flight track utilization was derived from study of origination and destination cities for scheduled airline traffic reported in ABAG Technical Memo II-I, and is shown in Table 2-6.

For San Francisco International Airport, the proportion of aircraft types in 1970 was determined from the scheduled aircraft information in ABAG Technical Memo II-I. For 1985, the breakdown of aircraft types was taken from Section C of ABAG Technical Memo II-I.

The contours reflect a very moderate increase in total number of air carrier operations by 1985 (approximately 15 percent) with the size of NEF contours shrinking due to the introduction of the newer, less noisy, high-bypass-ratio turbofan aircraft (Boeing 747, Douglas DC-10, and Lockheed 1011) and the assumed retrofit by 1985 of all 1970 aircraft to meet 1970 federal noise certification standards for new aircraft.

The 1970 and 1985 contours are shown in Figures 2-2 and 2-3 indicating land uses related to the contours. Figures 2-4 and 2-5 show schools and hospitals related to the noise contours. (Figures 2-2 through 2-7 are presented in detachable form at the end of this document.)

A net decrease in the number of acres of land, houses, schools, hospitals, and commercial areas affected by noise levels greater than 30 NEF will occur between 1970 and 1985. The areas enclosed within the NEF-30 contours for 1970 and 1985 are itemized in Table 2-7. The residential building count within the 30-NEF contour decreases 43.4 percent, from 22,822 units in 1970 to 12,924 units in 1985. The total land area within the NEF-30 contours decreases 35.6 percent, a reduction from 12,078.2 acres to 7,807.9 acres.

These noise contours assumed 380,000 annual airline operations. The final RASS report recommended a capacity of 310,000 annual airline operations, so the 1985 contours would shrink somewhat with the lower number of operations. These contours were made before actual noise data were available for the DC-10 and 1011 high-bypass-ratio transport aircraft. The first available noise data for the DC-10 indicate that the actual takeoff noise levels at full thrust are substantially less (5 to 8 EPNdB) than the earlier industry estimates. These lower noise levels will also result in reductions in the size of the projected 1985 NEF takeoff contours.

The land areas within the 30-NEF contours for 1985 would be less than indicated in Table 2-7.

Figures 2-6 and 2-7 show parks, recreational areas, and wildlife areas as related to the noise contours. As can be seen from reviewing the noise contours superimposed on the various land uses and comparing the data with Table 2-3, some conflicts are evident.

In the past, individual cities have attempted to evaluate the airport's impact on a city's land use plan. However, the land uses between cities were not coordinated in every case. In 1972, a Regional Planning Committee was formed, composed of one city councilman and one planning

Table 2-6

FLIGHT TRACK UTILIZATION PERCENTAGES AT
SAN FRANCISCO INTERNATIONAL AIRPORT – 1970 AND 1985
(1970 RUNWAY UTILIZATION)

Flight Track Segments	Takeoffs		Landings	
	1	2	1	2
01-A			12.0	12.0
01-B	18.2	7.5		
01-C	18.2	7.5		
01-D	36.4	14.9		
01-E	22.8			
01-H	13.5	14.9		
01-I	13.0	23.7		
01-J	13.0	23.7		
01-K	26.0	47.4		
01-L	31.2	31.2		
01-R	31.2	31.2	12.0	12.0
10-A			87.0	87.0
10-B	2.2	2.2		
10-C	2.2	2.2		
10-D	4.3	4.3		
10-E	1.9	3.2		
10-F	2.4	1.1		
10-R	2.2	2.2	87.0	87.0
19-R	0.3	0.3	0.3	0.3
19-L	0.3	0.3	0.3	0.3
28-A	16.4	16.4	0.3	0.3
28-B	16.4	16.4	0.3	0.3
28-C	32.8	32.8	0.5	0.5

Aircraft in each category:
1. Aircraft with trip length < 1500 nautical miles
2. Aircraft with trip length > 1500 nautical miles

Table 2-7

LAND USE WITHIN 30-NEF NOISE CONTOUR LEVEL
FOR SAN FRANCISCO INTERNATIONAL AIRPORT

Land Use	1970	1985[a]
Residential		
Acres	3,685.7	2,123.0
Building Count	22,822	12,924
Schools		
Acres	177.9	96.2
Building Count	36	21
Hospitals		
Acres	2.9	0
Building Count	1	0
Commercial		
Acres	2,852.8	1,821.6
Vacant		
Acres	3,130.6	2,002.4
Airport		
Acres	1,855.2	1,588.3
Cemetery		
Acres	373.0	176.5
Total Acres	12,078.1	7,807.9

[a]Assumes no change in land use between 1970 and 1985.

Source: P. Dygert, J. Ungerer, Airport Noise and Land Use, ABAG, March 1972

commissioner from each city in San Mateo County and one County Supervisor and the County Planning Commissioner. These individuals are also representatives on the Airport Land Use Commission. Since 39 cities are represented, an Airport Land Use Committee, composed of a portion of the Airport Land Use Commission, was formed. The Airport Land Use Committee is making specific land use recommendations upon which the Commission will act. When a regional land use plan is adopted by the Commission, existing regulations provide that the regional land use plan will supercede the individual city's plan. At that time, zoning and land-use changes will be governed by the Commission. This is the hoped-for goal but it is not yet operable.

This proposed land-use plan will not have a direct effect on the airport expansion program, but the land-use plan will tend to minimize potential future land-use conflicts as the remaining vacant land near the airport is converted to other uses.

In summary, the airport expansion program will provide for the larger and quieter jets. These larger jets, combined with an airport capacity limitation, will mean that less area is affected by noise within the 30-NEF contour in 1985 than occurred in 1970.

c. WILL THE DEVELOPMENT RESULT IN DISPLACEMENT OF A SIGNIFICANT NUMBER OF PEOPLE?

The San Francisco International Airport expansion program does not involve the displacement or relocation of people.

d. WILL THE DEVELOPMENT HAVE A SIGNIFICANT AESTHETIC OR VISUAL EFFECT?

The proposed expansion will have a significant aesthetic and visual effect. A goal of the expansion is to create one of the most beautiful, convenient, compact, and safe airports in the world, close to a major metropolitan area, where total transportation time would be minimized. The expansion program is under the architectural and aesthetic control of one firm even though construction plans will be prepared by a number of firms. The main terminal buildings will be three stories high and the boarding areas will be two stories high. The central parking structure will be five levels high for automobile parking and will have a sixth level devoted to a People Mover System. A Federal Aviation Administration control tower nominally 200 feet high will be located in the center of the parking structure.

Some residences in the cities of Hillsborough, Burlingame, Milbrae, San Bruno, and South San Francisco have views of the airport because they are at a higher elevation than the airport. In addition to the residents viewing the airport, millions of air passengers will pass through the airport annually.

The expansion program, when it is completed, will present a series of structures with clean lines, architecturally integrated so that they will all have a similar appearance. The existing East Terminal will be remodeled so that it will blend in with the new structures to be constructed. Several small and old structures will be demolished and replaced by better looking, more functional buildings. Many of the baggage trains that are now traveling on the apron between airlines will be replaced by an underground interline baggage system. The Bay Area Rapid Transit (BART) system will be in a tunnel under the airport and, when operational, will eliminate the need for a number of surface vehicles.

In addition to the many structures to be constructed that contribute to the total visual effect, an item for art enrichment is a part of the expansion program.

The expansion program will more than double the number of square feet of the building space over existing space and is expected to be a visual improvement over existing conditions.

e. WILL THE DEVELOPMENT DIVIDE OR DISRUPT AN ESTABLISHED COMMUNITY OR DIVIDE EXISTING USES?

The proposed expansion at San Francisco International Airport will not physically divide or disrupt an established community or divide existing uses. All the expansion is being accomplished within existing airport boundaries.

f. WHAT WILL BE THE EFFECT ON AREAS OF UNIQUE INTEREST OR SCENIC BEAUTY?

The San Francisco International Airport expansion program is being accomplished within the existing airport boundaries. It does not involve areas of unique interest or scenic beauty.

g. WILL THE DEVELOPMENT DESTROY OR DEROGATE IMPORTANT RECREATIONAL AREAS?

Figure 2-6 shows the existing parks near San Francisco International Airport; also shown are the noise contours for 1970. Figure 2-7 shows the parks and expected noise contours for 1985.

The parks include private golf courses, municipal parks in several cities, county parks, proposed county parks, and state parks.

The proposed development will not physically touch any park. A comparison of the 1970 and 1985 NEF contours shows that the 1985 contours are smaller, indicating a lowering of the aircraft noise levels as compared with 1970. This indicates that as the quieter aircraft become predominant, and for approximately the same number of annual operations, the parks and recreational areas will have less aircraft noise.

h. WILL THE DEVELOPMENT SUBSTANTIALLY ALTER THE PATTERN OF BEHAVIOR FOR A SPECIES?

The expansion program for San Francisco International Airport will not substantially alter the pattern of behavior for a species. The development is being accomplished on the existing airport in areas that are presently utilized for commercial or industrial airport uses.

i. WILL THE DEVELOPMENT INTERFERE WITH IMPORTANT WILDLIFE BREEDING, NESTING, OR FEEDING GROUNDS?

The Regional Airport Systems Study, The Effect of Aviation on Physical Environment and Land Uses in the Bay Region prepared by Wilsey and Ham, describes the existing knowledge of the ecological relationships between species living in the Bay Region and environmental changes instigated by man. The physical characteristics of animal and vegetative species within the wildlife habitats adjacent to the airport are described. Due to limitations of resources and time, only a general identification of these complex and intricate habitats based on today's knowledge was made. Only through more detailed research and analysis of these habitats will man begin to understand their ecological relationships and his impact on them through modification of the environment.

Shallow Bay waters are on the east side of the airport. These waters, as they move by tidal action across the mud flats and into the marshes, serve as a transfer medium. They bring water and minerals to the salt marsh and remove food and oxygen as they leave. They supply the filter-feeding invertebrates in the mud with life-giving detritus. They move the fish, particularly in their young stages, into the rich mix along the edges of the Bay. And finally, they provide the medium in which some diving birds — e. g., grebes, mergansers, and loons — may find sustenance, or through which diving ducks — e. g., canvasbacks and scaup — may descend to their food in the muds below. Most of the organisms in the water are minute but play a major role in the intricate web of life.

The phytoplankton of the Bay is dominated by diatoms with some 27 genera being represented. A few single-celled green algae and dinoflagellates are also present in Bay waters. Diatoms may at times be so prevalent that about 10,000,000 are present in a quart of Bay water.[11] However,

[11] Storrs, P.N., Selleck, R.E., and Pearson, E.A., A Comprehensive Study of San Francisco Bay, 1963-64, S.E.R.L. Report 65-1; Berkeley, University of California, 1965

in spite of their large numbers, their open-water production of food for aquatic life compared to production in salt marshes is but a small fraction of the whole.

Protozoans in the Bay are mainly either ciliates or flagellates. These microscopic animals sometimes occur in concentrations of 20,000 per quart and may represent some six different genera.[11]

There are four major groups of zooplankton represented in Bay waters. They range from the microscopic plants and animals listed above to the larger forms, such as the fish, which will be discussed later. The four major groups are:

- Polychaeta larvae (segmented worms)
- Copepods (crustacean forms)
- Fish larvae
- Snail larvae

The copepods are by far the most abundant and widespread of these forms of life with as many as 75 per quart being taken per sample. They are barely visible to the naked eye because they are often less than one-eighth of an inch long.

Shrimp constitute an important part of the Bay ecosystem because they forage for food both on the bottom and in the waters of the Bay. The three shrimp types that are common or of great ecological importance are the Bay shrimp (Crago franciscorum), the blacktail shrimp (Crago nigricauda), and the opossum shrimp (Neomysis awatschansis). The Bay shrimp was once highly prized as human food, but with the present high level of pollution of the Bay it is not so used. The opossum shrimp is the major food of young striped bass, an important sport fish.

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[11] Storrs, et al., op. cit.

There are about 125 species of fish in the Bay.[12] San Francisco Bay plays a vital part in both commercial and sports fishing. It has been estimated that over $20 million dollars per year are spent on sports fishing alone. The State Department of Fish and Game has conducted surveys during recent years (1963-66) that indicate great numbers of certain species. Striped bass, for example, are thought to comprise a population of several million. The northern anchovy and shiner perch are probably even more numerous. Of some 70 species caught in the Department study of San Francisco Bay proper, the highest species diversity was near Treasure Island. The lowest diversity (average of 10 species) was found south of Dumbarton Bridge.[13] The following is a list of the 20 most common fish species south of the Richmond Bridge, listed by relative abundance:

Northern anchovy (most numerous fish in the Bay)
Shiner perch
English sole
Pacific herring
Bay goby
Speckled sandab
Jacksmelt
White croaker
Pacific staghorn sculpin
Pacific tomcod
Northern midshipman
Topsmelt
California tonguefish
American shad
Pile perch
Starry flounder
Bat ray
Brown smooth hound shark
Spiny dogfish shark
Leopard shark

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[12] Aplin, A., San Francisco Bay Study, Menlo Park, 1963; and Skinner, J.E., An Historical Review of the Fish and Wildlife Resources of the San Francisco Bay Area, 1962

[13] Aplin, A., San Francisco Bay Study, Menlo Park, 1963

The grazing filter-feeders that depend on plankton are at the top of the list, while large predator types such as sharks are at the bottom, thus exemplifying the typical pyramid of numbers in a predator food chain. In the northern bays the striped bass would be included well up the list because of its great abundance.

The major type of bird using the shallow waters dives for food. Some catch food near the surface: pelicans and terns. Others dive into water several feet: loons, grebes, and mergansers. The diving ducks go all the way to the bottom to feed in the mud.[14] Some of the common birds of the shallow waters are listed below:

- Diving fish-feeders

  Western grebe
  Eared grebe (often eat feathers)
  Red-throated loon
  Double-crested cormorant
  Red-breasted merganser

- Diving ducks

  White-winged scoter
  Surf scoter
  Greater scaup
  Lesser scaup
  Canvasback
  Ruddy duck

- Surface feeders

  Brown pelican
  Caspian tern (nests along Bay)
  Forster's tern (nests along Bay)
  Least tern (endangered species — nests along Bay)
  Gulls (five species)

Mammals of the shallow waters are relatively sparse; only the harbor seal and the sea lions can be called common. Porpoises sometimes

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[14] Sibley, C.G., The Birds of the South San Francisco Bay Region, San Jose, 1952

find their way into San Francisco Bay. Some 300 to 400 harbor seals live in the Bay and require hauling out areas along the shore for resting.

Mud flats are an extensive feature of San Francisco Bay and cover tens of thousands of acres. The flats are substrate that may have a moisture content of close to 75 percent by weight. They serve as a surface on which many microorganisms such as blue-green algae diatoms and nematodes may abound. A variety of invertebrates (annelid worms and clams) thrive in the mud and are in turn fed upon by various shorebirds when the flats are exposed; when the tide is in, diving ducks and fish find nourishment there. Thus, this unique surface serves both essentially terrestiral organisms — the shore birds — and aquatic forms — the ducks and fish, both finned and shell. The fish, of course, are restricted to the shallow water over the flats and are identified under that habitat.

Various algae, both unicellular and multicellular, live on the mud flats. Diatoms and blue-greens represent the former while green algae, e.g., sea lettuce (Ulva sp.),and red algae represent the latter.

Over 100 species of invertebrates have been collected from San Francisco Bay muds. Some of the more important ones are listed below:

- Roundworms or nematodes
- Ribbon worms or nemerteans
- Segmented worms or annelids
  - (Neanthes succinea)
  - (Nercis diversicolor)
- Crustaceans
  - Barnacles (Balanus spp.), not living in the mud but on nearby objects
  - Shore crabs (Hemigrapsus spp.)
  - Commercial crab (Cancer magister)
- Molluscs
  - California horn snail (Cerithidea californica)
  - Moon snail (Polinices Lewisi)
  - Mud snails (Nassarius mendicus)
  - Sea slugs or nudibranchs
  - Bay mussel (Mytilus edilis)

Ribbed mussel (Modiolus demissus)
Oysters (various genera)
Bent-nosed clam (Macoma nasuta)
Soft shell clam (Mya aranaria)
Japanese littleneck clam (Tapes semidecussata)

Figure 2-8 shows a generalized description of the water areas adjacent to the airport. Figure 2-6 shows a portion of the proposed wildlife refuge in San Mateo County as related to existing aircraft flight paths.

A clear relationship between wildlife and aircraft noise and operations has not been established. Information is only recently becoming available on the effects of sound on living organisms. One report indicated an increased wheat plant size when the plants were subjected to sound frequencies between 5,000 and 300,000 cycles per second.

Wild plants and animals abound in the San Francisco Bay region; over a thousand different kinds of higher plants and several hundred bird and mammal species are present. If all the invertebrates were included, the list of animal species would probably run into the tens of thousands. Their sensitivity to noise and air pollutants is essentially unknown.

An evaluation of the impact of the airport expansion on wildlife cannot be made in a quantitative manner. However, it is shown elsewhere in this environmental impact statement that air pollution is expected to decrease compared to 1970 levels, noise is expected to be less compared to 1970 levels, and waste discharges will be "cleaner" compared to 1970 levels; thus, the 1985 environment will be better than that of 1970.

Two projects involve construction in Bay waters: the Deep Water Sanitary Outfall and the Seaplane Harbor Rough Fill. These two projects will be the subject of separate impact statements.

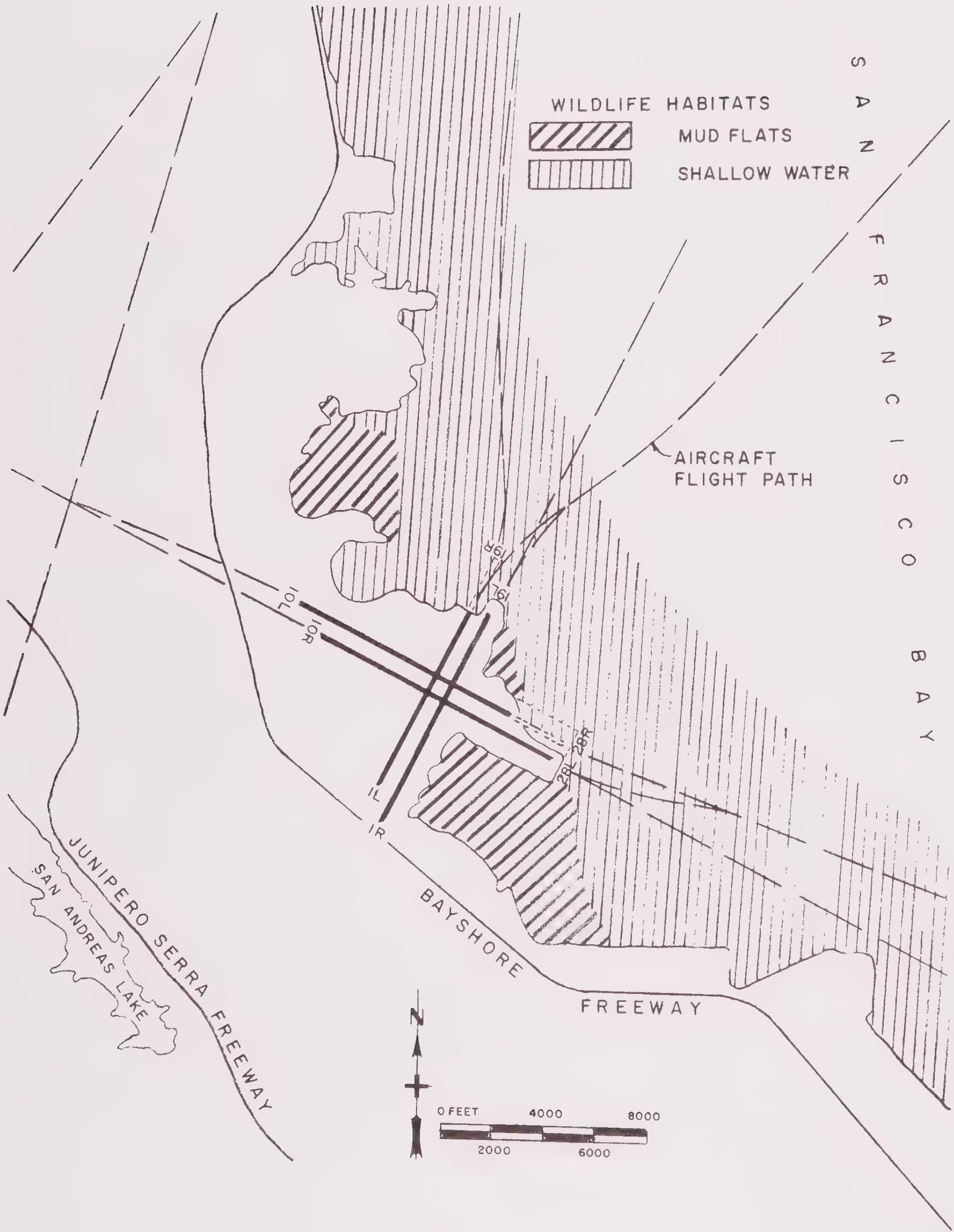

Figure 2-8. Wildlife Habitats near San Francisco International Airport

j. WILL THE DEVELOPMENT SIGNIFICANTLY INCREASE AIR OR WATER POLLUTION?

Air Quality

In February 1971, the Bay Area Pollution Control District produced a report, Aviation Effect on Air Quality. This report described the existing air quality in the Bay Area in 1970 and the expected air quality in 1975, 1980, and 1985. It calculated the amount of emissions expected from aircraft at each airport in the future years, as well as emissions expected from other sources. The following paragraphs are a synopsis of that report.

Total emissions of air contaminants to the atmosphere from all sources in the nine-county San Francisco Bay Area are expected to decline substantially over the next 15 years, but the portion attributable to aviation activity at all airports will increase. Total nine-county emissions for 1970 are estimated to be 9,463 tons per day. This will decline to 3,600 by 1985, with the aviation portion increasing from 138 tons per day to 200[15] for all airports in the Bay Area. Emissions from aircraft are estimated on the basis of operations within the airshed below an altitude of 3,500 ft. The emissions at San Francisco International Airport are expected to decline slightly between 1970 and 1985.

Total emissions are as estimated by the Bay Area Air Pollution Control District and include factors that are not detailed in this statement. Among the basic assumptions that underlie these calculations are that new motor vehicles will meet federal and state emission requirements for each model year from 1971 to 1976, that no more stringent controls will be mandated for models later than 1976, that the retirement/replacement ratio of automobiles will remain constant, that the regulations of the District will be

[15] Gillfillan, op. cit.

fully effectuated within the nine-county Bay Area, and that area-wide growth will continue.

Aircraft emission rates per operation by type of aircraft are shown in Tables 2-8 and 2-9.

These emissions rates were obtained from a variety of sources and in certain instances data were conflicting, so the information was selected, averaged, or thrown out, depending on judgmental decisions by Bay Area Pollution Control District personnel. The emission rates were then multiplied by the number of aircraft operations in each category in 1970 and 1985 to obtain the number of tons of pollutants per day emitted.

The report Aviation Effect on Air Quality estimated 442,900 annual airline operations in 1985 at San Francisco International Airport. The Regional Airport Systems Study Final Plan Recommendation stated that San Francisco International Airport has a recommended airline operation capacity of 310,000 annual movements in 1985. To estimate the pollutant emissions in 1985 for this lower figure, each type of aircraft operation for 1985 was reduced by a factor of 3,100, divided by 4,429, and then totaled. Helicopter operations and general aviation operations were taken to be the same as in the report on Aviation Effect on Air Quality.

The results are given in Tables 2-10 and 2-11, which show the estimated pollutants produced by vehicles and aircraft on San Francisco International Airport in 1970 and 1985. In addition, vehicles going to and from the airport are expected to produce 38 tons per day of pollutants in 1985. This figure was calculated using the 80-tons-per-day figure quoted in the RASS Final Plan Recommendation for all airline airports for the Bay Area and removing the estimated transit use passengers from the total, then proportioning the 80 tons among the airports based on the estimate of annual passengers who are expected to use automobiles.

Table 2-8

COMMERCIAL AIR CARRIER EMISSION FACTORS

Aircraft and Engine	Fuel per Engine per Operation (gal)	No. of Engines	Total Fuel per Operation (gal)	Contaminant Emissions per Aircraft (lb/operation)					
				Part	CO	NO_x	Org.	SO_x	Total
Convair 880									
CJ805	64	4	256	19.5	33.0	10.0	36.4	4.0	103
Rotorcraft	10	2	20	1.5	2.6	0.8	2.8	0.3	8
B-720									
JT3C	89	4	356	23.1	39.9	9.6	9.3	5.6	88
JT3D	89	4	356	22.4	84.7	11.7	50.6	5.6	175
B-737-200, DC-9									
JT8D Old	66	2	132	10.7	19.0	4.2	7.5	2.1	44
New	66	2	132	7.9	16.2	6.3	4.0	2.1	37
B-727-100, B-727-200									
JT8D Old	66	3	198	16.0	28.5	6.3	11.3	3.1	65
New	66	3	198	11.9	24.4	9.5	5.9	3.1	55
B-707, DC-8, DC-8-60									
JT4	89	4	356	24.9	65.5	7.5	27.8	5.6	131
JT3D	89	4	356	22.4	84.7	11.7	50.6	5.6	175
DC-10, L-1011									
CF6 or RB. 211	111	3	333	11.0	42.6	65.6	11.0	5.2	135
B-747									
JT-9D	95	4	380	12.5	71.1	13.3	12.9	5.9	116

Table 2-9

GENERAL AVIATION EMISSION FACTORS AND FUEL USAGE

Engine	Part.	Emission Factors (lb/100 gal fuel)			
		CO	NO_x	ORG.	SO_x
Jet	7.6	12.9	1.9	4.3	1.56
Turboprop	10.4	5.4	5.6	3.9	1.56
Gasoline	1.2	245.0	14.7	49.6	-

Aircraft	Fuel Usage (gal/operation)	Emission Factors (lb/operation)				
		Part.	CO	NO_x	Org	SO_x
Gasoline						
Single engine						
1-3 place	1.0	0.012	2.45	0.147	0.496	-
4+ place	1.5	0.018	3.67	0.221	0.744	-
Multiengine						
Under 600 hp	3	0.036	7.35	0.441	1.488	-
Over 600 hp	8	0.096	19.6	1.176	3.968	-
Rotocraft	1	0.012	2.45	0.147	0.496	-
Turbine Fuel						
Turboprop[a]	25	2.6	1.35	1.4	0.975	0.39
Turbojet	64	4.86	8.26	1.22	2.75	1.00
Third-level air carrier[a]	25	2.6	1.35	1.4	0.975	0.39

[a]Third level air carriers counted with general aviation.

Table 2-10

AIR CONTAMINANT EMISSIONS
AT
SAN FRANCISCO INTERNATIONAL AIRPORT — 1970
(tons per day)

	Part.	Co	No	Org	SO_x	Total
Aircraft emissions						
Air carrier	8.1	22.3	3.6	11.7	1.8	47.5
Jet fuel dumping	—	—	—	1.8	—	1.8
General aviation	0.1	0.1	0.1	0.1	—	0.4
Subtotal	8.2	22.4	3.7	13.6	1.8	49.7
Ground emissions (nonaircraft)						
Motor vehicles	0.1	8.5	0.6	1.6	—	10.8
Fuel handling	—	—	—	0.1	—	0.1
Engine test cell	0.4	1.1	0.2	0.6	0.1	2.4
Subtotal	0.5	9.6	0.8	2.3	0.1	13.3
Total emissions	8.7	32.0	4.5	15.9	1.9	63.0

Table 2-11

AIR CONTAMINANT EMISSIONS
AT
SAN FRANCISCO INTERNATIONAL AIRPORT — 1985
(tons per day)

	Part.	Co	No	Org	SO_x	Total
Aircraft emissions						
Air carrier	5.9	20.3	12.7	6.4	2.0	47.3
General aviation	0.2	0.2	0.1	0.1	—	0.6
Subtotal	6.1	20.5	12.8	6.5	2.0	47.9
Ground emissions (nonaircraft)						
Motor vehicles	0.1	1.2	0.2	0.1	0.1	1.7
Fuel handling	—	—	—	—	—	0.2
Engine test cell	0.4	1.2	0.6	0.5	0.1	2.8
Subtotal	0.5	2.4	0.8	0.8	0.2	4.7
Total emissions	6.6	22.9	13.6	7.3	2.2	52.6

The total air emissions are summarized in Table 2-12, which indicates that the SFO-related air contaminant emissions for 1985 will decrease slightly over 1970 levels.

Table 2-12

TOTAL NINE-COUNTY AIR EMISSIONS
(tons per day)

	Nine-County 1970	SFO 1970 Portion	Nine-County 1985	SFO 1985 Portion
Total nine-county (all sources)	9,463	NA	3,600	90.6
Aircraft	121	49.7	200	47.9
Other airport	17	13.3	10	4.7
Autos to airports	NA	NA	80	38.0

Pollutant levels caused by airport operations at specific community locations are also of concern. Aircraft ground operations and ground vehicle operations have the greatest potential for adverse effects upon adjacent communities. The Bay Area Pollution Control District developed a "hybrid diffusion model" as applied to the operations at San Francisco International Airport to assess quantitatively the community impact. This is a mathematical model calculated by a computer, and is explained in detail together with the relevant assumptions in Aviation Effect on Air Quality Regional Airport Systems Study, February 1971. The results of the model are described in the following paragraphs.

At San Francisco International Airport, the present demand levels already show an appreciable impact on air quality (see Table 2-13). At receptor sites 2 and 4 near the ends of the major runway complexes (see Figure 2-9), high levels might be expected. Nevertheless, the calculated levels

Table 2-13

CALCULATED AIR QUALITY IMPACT FROM AIRCRAFT GROUND OPERATIONS AND ASSOCIATED AUTOMOTIVE TRAFFIC UNDER PRESENT (1970) DEMAND LEVELS AT INDICATED DOWNWIND RECEPTOR SITES

	Receptor Site							
	SFO-AGO				SFO-AAT			
Contaminant	1	2	3	4	5	6	7	8
Particulates ($\mu g/m^3$:24-hr avg)								
C	1	312	3	490	1	28	T	28
E	21	698	34	1070	4	46	1	46
Carbon monoxide (ppm)								
C	T	3.0	T	4.7	T	2.0	T	2.0
E	0.6	14.0	0.9	21.2	0.6	5.6	0.2	5.6
Nitrogen oxides (ppm)								
C	T	0.24	T	0.38	T	0.14	T	0.14
E	0.05	1.12	0.08	1.70	0.04	0.39	0.01	0.39
Organics (ppm, as butane)								
C	T	0.70	0.01	1.09	T	0.20	T	0.20
E	0.14	3.25	0.23	4.92	0.06	0.56	0.02	0.56
Sulfur oxides (ppb)								
C	1.3	54.0	5.6	84.6	—	—	—	—
E	10.4	252.0	16.4	382.0	—	—	—	—

Note: AGO — Aircraft Ground Operations
AAT — Associated Automotive Traffic
T — Trace
C — Typical Unstable Meteorological Conditions
E — Adverse Stable Meteorological Conditions

are surprisingly high for particulates and for sulfur oxides. Particulate levels under C conditions (typical unstable) at site 4 are 490 micrograms per cubic meter, which is almost five times the California State standard of 100 micrograms per cubic meter for 24-hour particulates. These levels must be considered in addition to a background from all other upwind Bay Area sources, which already show levels in excess of 60 micrograms per cubic meter at Bay Area Air Pollution Control District monitoring stations.

One ameliorative factor is operative in air traffic control procedures at San Francisco International Airport. Under light-wind conditions, the 28L-28R runway complex is used for landings, and the perpendicular 1L-1R runway complex is used for takeoffs. Thus, under conditions most likely to be adverse, the concentrations at sites 2 and 4 are substantially reduced (by a factor approaching two).

At receptor site 4 (in Burlingame), actual particulate levels have been monitored by the Bay Area Air Pollution Control District in 1970. Values as high as 240 micrograms per cubic meter have been measured (under C stability conditions with an elevated marine inversion), thus confirming very well the calculations and the model, as adjusted to airport operating practices.

The other contaminants can be evaluated in terms of hourly rather than 24-hour averages, and none of them exceeds State standards. However, the SO_2 level of 84.6 ppb would, if sustained for 12 hours, give a 24-hour average in excess of the State standard of 40 ppb. The CO level of 4.7 ppm could, when added to freeway levels, cause State standards to be exceeded (as has been observed at Burlingame). The organics level of 1.09 ppm is not serious in terms of photochemical oxidant formation at

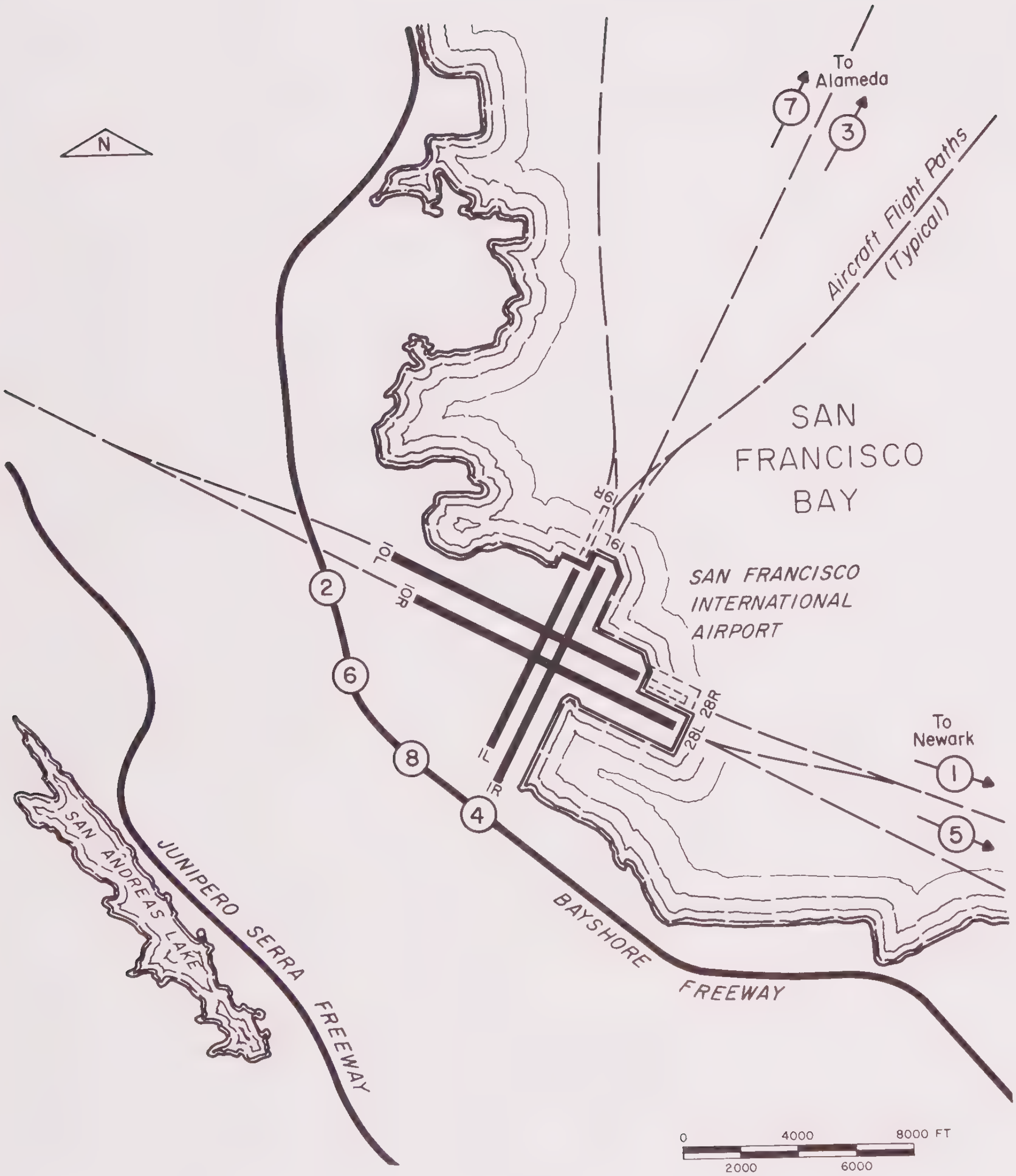

Figure 2-9. Location of Receptors

the site, but reactive components of the exhaust may add to oxidant formation downwind. In addition, the level is high enough to create odor problems at sites 2 and 4.

Receptor site 1, 27 kilometers downwind, is of interest since it lies in the Newark-Fremont area with frequently measured high contaminant values. At this distance, the impact of San Francisco International Airport is not calculated to be significant, except for particulates under E conditions. Since E conditions could be sustained over smooth water at night, the particulate contribution of 21 micrograms per cubic meter cannot be completely disregarded.

The future projections for San Francisco Airport (see Tables 2-14 and 2-15) do not show any major differences from present conditions. There is slight improvement with increasing controls at the 450,000 annual aircraft operations level, followed by return to present values at a level of 588,000 annual aircraft operations. These levels are far in excess of the 370,000 annual operations now expected to be the total airport capacity. The annual airport capacity has been reduced because of turbulence caused by large aircraft, resulting in a greater separation between aircraft than occurred in 1970. This means that the expected pollution levels will be less than shown in the Tables 2-14 and 2-15.

Table 2-14

CALCULATED AIR QUALITY IMPACT FOR AIRCRAFT GROUND OPERATIONS AND ASSOCIATED AUTOMOTIVE TRAFFIC FOR 450,000 TOTAL ANNUAL AIRCRAFT OPERATIONS AT DOWNWIND RECEPTOR SITES

Contaminant	Receptor Site							
	SFO-AGO				SO-AAT			
	1	2	3	4	5	6	7	8
Particulates ($\mu g/m^3$:24-hr avg)								
C	1	290	3	456	1	28	T	28
E	20	650	32	990	4	46	1	46
Carbon monoxide (ppm)								
C	T	3.5	T	5.5	T	0.6	T	0.6
E	0.7	16.4	1.1	24.8	0.2	1.6	0.1	1.6
Nitrogen oxides (ppm)								
C	0.02	0.69	0.07	1.10	T	0.12	T	0.12
E	0.14	3.22	0.23	4.90	0.03	0.32	T	0.32
Organics (ppm, as butane)								
C	T	0.70	0.01	1.09	T	0.04	T	0.04
E	0.14	3.25	0.23	4.92	0.01	0.11	T	0.11
Sulfur oxides (ppb)								
C	1.6	67.6	70.0	106.0	—	—	—	—
E	13.4	315.0	20.5	477.0	—	—	—	—

Note: AGO — Aircraft Ground Operations
AAT — Associated Automotive Traffic
T — Trace
C — Typical Unstable Meteorological Conditions
E — Adverse Stable Meteorological Conditions

Table 2-15

CALCULATED AIR QUALITY IMPACT FOR AIRCRAFT GROUND OPERATIONS AND ASSOCIATED AUTOMOTIVE TRAFFIC FOR 588,000 TOTAL ANNUAL AIRCRAFT OPERATIONS AT DOWNWIND RECEPTOR SITES

Contaminant	Receptor Site							
	SFO-AGO				SOF-AAT			
	1	2	3	4	5	6	7	8
Particulates ($\mu g/m^3$:24-hr avg)								
C	1	312	3	490	2	56	T	56
E	21	698	34	1070	8	92	2	92
Carbon monoxide (ppm)								
C	T	4.4	0.1	6.9	T	0.2	T	0.2
E	0.8	20.6	1.4	31.2	0.1	0.5	T	0.5
Nitrogen oxides (ppm)								
C	T	1.28	0.01	2.02	T	0.05	T	0.05
E	0.27	5.96	0.43	9.05	0.01	0.13	T	0.13
Organics (ppm, as butane)								
C	T	0.65	T	1.01	T	0.01	T	0.01
E	0.13	3.02	0.21	4.57	T	0.03	T	0.03
Sulfur oxides (ppb)								
C	1.6	67.5	7.0	106.0	0.4	11.8	0.1	11.8
E	13.0	315.0	20.5	478.0	4.6	32.4	1.2	32.4

Note: AGO — Aircraft Ground Operations
AAT — Associated Automotive Traffic
T — Trace
C — Typical Unstable Meteorological Conditions
E — Adverse Stable Meteorological Conditions

Water Quality

The San Francisco International Airport discharges effluent into the Bay from three sources: a sewage treatment plant, and two systems of combined storm drain and industrial treatment.

The facilities that are presently used in controlling effluent to State standards consist of the following:

- Sewage. A new 2.2-million-gallon-per-day (average) sewage treatment plant at the North edge of the airport property
- Industrial Waste. Source control by means of separators at the tenants' facilities followed by two oxidation ponds for detention of effluent for 13 days (North Pond) and 7 days (South Pond)

Present water quality requirements are in substantial compliance with State water quality standards. The two exceptions concern toxicity in sewage treatment and toxicity in industrial wastes. Toxicity is determined by whether or not a stickleback fish dies within 96 hours of exposure to a sample of the water.

Table 2-16 shows a detailed comparison of sewage test results and the corresponding standards. All standards were in substantial compliance for the year except for toxicity. The toxicity test (requiring a stickleback fish to survive in the test waters for 96 hours) is difficult to perform because the fish may die from causes unrelated to water quality, such as sudden temperature changes, inadequate oxygen during shipment of the fish, etc. The environmental impact statement for the South San Francisco deep water outfall indicated that using a brackish water fish (the stickleback) may be overly conservative for salt waters since saltwater species seem not to be affected as much by foreign substances as brackish-water fish.

Table 2-16

SAN FRANCISCO INTERNATIONAL AIRPORT WATER QUALITY CONTROL PLANT — SEWAGE TREATMENT TEST RESULTS (Sampling Period — August 1971 to September 1972)

Receiving Waters (Bay)						
Parameter	Test Results: Minimum	Maximum	Average	Median	State Requirement Resolution No. 70-12	Percentage In Conformance
Dissolved oxygen	5.5	13.5	9.2	9.1	minimum 5.0	100
pH	7.1	8.4	7.8	8.1	7.0 to 8.5	100
Dissolved sulfides	0	0	0	0	maximum 0.1	100

	Number of Days Observed	Number in Violation	Percentage In Conformance
Floating solids	284	0	100
Floating oil	284	0	100
Discoloration	284	0	100
Odor	284	0	100

Waste Stream (Effluent From Plant Before Entering Bay)						
Parameter	Test Results: Minimum	Maximum	Average	Median	State Requirement Resolution No. 70-12	Percentage In Conformance
Coliform	2	1,400	99	23		97.5
Toxicity (96-hr survival)						
Undiluted	0	100%	29%	5%	90%	20
TLm	36%	100%	75.6%	76%		
Biochemical oxygen demand removal	72.5%	97.7%	92.5%	95%	90%; or 80% in two consecutive samples	100
Settleable matter (ml/L/1 hr)	0	0.5	0.1	0.1	0.5	100

Source: San Francisco International Airport Engineering Division

Tables 2-17 and 2-18 show detailed comparisons of industrial waste treatment test results and the corresponding standards. Data are shown separately for the North Pond and the South Pond. The results show that in all cases the ponds were in substantial compliance with standards over the 20-month period ending in September 1972.

For both sewage and industrial waste treatment, corrective measures are put into effect when water quality tests exceed standards. This includes enforcement of regulations applied to tenants on the airport property.

The Phase II airport expansion program provides for additional effluent control capacity to meet project needs to 1985. The elements of the development program that concern effluent treatment are:

- Construction of an industrial waste plant
- Deep water sanitary outfall to one mile
- Industrial waste force mains from oxidation ponds to the industrial waste plant
- Expansion of sewage treatment plant
- Industrial waste-pumping stations
- Replacement of existing sanitary sewers (to increase capacity and operating pressure)
- Stand-by power station for the 2.2 mgd sewage plant

The bases for developing these expanded water quality control facilities were:

- A projection of additional wastewater by type and constituent characteristics brought about by the general Phase II expansion program
- A forecast of water quality standards applicable to the projected period

Table 2-17

SAN FRANCISCO INTERNATIONAL AIRPORT DRAINAGE STATION NO. 1 — SOUTH OXIDATION POND INDUSTRIAL WASTE TREATMENT TEST RESULTS (Sampling Period — Monthly, January 1971 to September 1972)

Parameter	Units	Test Results				State Requirement Resolution No. 692[a]	Percentage In Conformance
		Minimum	Maximum	Average	Median		
Grease	mg/L	5.7	26.0	12.9	11.0	20	95
Phenols	mg/L	0.02	0.76	0.19	0.08	0.50	89
Cyanide	mg/L	<0.06	<0.06	<0.06	<0.06	1.0	100
Cadmium	mg/L	0.02	0.20	0.04	0.02	1.0	100
Total Chromium	mg/L	0.02	0.06	0.03	0.02	2.0	100
Copper	mg/L	0.02	0.05	0.03	0.02	0.26	100
Lead	mg/L	0.02	0.17	0.04	0.03	0.10	95
Nickel	mg/L	0.02	0.08	0.03	0.02	Not specified	100
Silver	mg/L	0.02	0.05	0.03	0.02	1.0	100
Zinc	mg/L	0.02	1.0	0.19	0.07	1.0	100
pH	mg/L	6.8	10.2	7.9	7.8	6.5 to 8.5	85
Settleable Solids	ml/L/1 hr	0.0	0.2	0.1	0.1	0.5	100
Bio-Assay (% survival in 96 hr)		0	100	66	90	90	67

[a]Resolution 692, California Regional Water Pollution Control Board No. 2, San Francisco Bay Region, August 19, 1965.

Source: San Francisco International Airport Engineering Division

Table 2-18

SAN FRANCISCO INTERNATIONAL AIRPORT DRAINAGE STATION NO. 2 — NORTH OXIDATION POND INDUSTRIAL WASTE TREATMENT TEST RESULTS (Sampling Period — Monthly, January 1971 to September 1972)

Parameter	Units	Test Results				State Requirement Resolution No. 692	Percentage In Conformance
		Minimum	Maximum	Average	Median		
Grease	mg/L	3.9	18	10.1	9.0	20	100
Phenols	mg/L	0.01	0.75	0.18	0.12	0.50	94.75
Cyanide	mg/L	0.06	0.12	0.06	0.06	1.0	100
Cadmium	mg/L	0.02	0.19	0.05	0.03	1.0	100
Total Chromium	mg/L	0.02	0.48	0.09	0.08	2.0	100
Copper	mg/L	0.02	0.13	0.03	0.03	0.26	100
Lead	mg/L	0.02	0.15	0.05	0.03	0.10	85
Nickel	mg/L	0.06	0.28	0.11	0.10	Not specified	100
Silver	mg/L	0.02	0.07	0.03	0.02	1.0	100
Zinc	mg/L	0.02	1.0	0.19	0.09	1.0	100
pH	mg/L	6.9	8.4	7.9	8.0	6.5 to 8.5	100
Settleable Solids (ml/L/1 hr)		0.0	0.1	0.1	0.1	0.5	100
Bio-Assay (% survival in 96 hr)		0	100	92	99	90 Min.	89.5

Source: San Francisco International Airport, Engineering Division

The forecast of future water quality standards applicable to the airport was based on Interim Water Quality Control Plan for the San Francisco Basin, California Regional Water Quality Control Board, June 1971. The policy guidelines and objectives contained in this basic reference are recognized as being imprecise and subject to quantitative definition. However, to provide a basis for Phase II expansion requirements, the firm of Metcalf and Eddy, Palo Alto, was retained by the airport to assist in forecasting what the water quality standards would be and to relate these projected standards to facility requirements. The additional effluent control facilities shown in the Phase II plan are the result of this study.

Since the development of the effluent facility plan for Phase II, the Federal Government enacted the Federal Water Quality Control Act of 1972. Future standards for water quality in the airport region are now uncertain. Title III of the Act applicable to the airport provides that point sources "shall require application of the best practicable control technology currently available as defined by the Administrator." And by July 1, 1983, Title III requires effluent limitation for categories and classifications of point sources that "shall require application of the best available technology economically achievable...which will result in reasonable further progress toward the national goal of the elimination of all pollutants."

The Act requires local cognizant authorities to submit standards and implementation plans to achieve the goal set out in the Act. These local water quality requirements have yet to be developed for public hearings and enactment. The outlook, however, is for progressively more stringent standards from the present through 1985.

Since the State of California has already moved aggressively in the field of water quality management, the impact of the Act on present standards and the timetable for new standards may not prove to be substantial. Considerable study was involved in preparing the Interim Water Quality Control Plan for the San Francisco Bay Basin.

In summary, the present effluent treatment facilities are in substantial compliance with State requirements for water quality, with special control procedures needed from time to time to meet exceptions.

The sewage and industrial waste facilities under the Phase II expansion were designed to meet presently forecast requirements of the cognizant State Water Quality Control Board. However, the impact of the Federal Water Quality Control Act of 1972 is yet to be determined and Phase II water treatment facilities and control procedures may require further augmentation to meet evolving new and more stringent standards brought about by this Act.

k. WILL DEVELOPMENT ADVERSELY AFFECT THE WATER TABLE OF AN AREA?

The water table underlying San Francisco International Airport is at sea level. The completed development should have no adverse effect on the water table. No pumping of water is contemplated.

Water for domestic use or fire-fighting purposes is obtained from the Crystal Springs Reservoir. The airport water usage is expected to be 4.7 percent of the County of San Mateo's water use in 1985.

l. EMPLOYMENT IMPACT

The proposed expansion, together with more passengers, will increase the number of employees working on or immediately adjacent to the airport. The following reports have described the expected employment changes:

- Wilsey and Ham, The Effect of Aviation on Physical Environment and Land-Uses, 1971

- William Goldner, et al., Economic and Spatial Impacts of Alternative Sizes and Locations in the San Francisco Bay Region, July 1971, Volumes 1 and 2

These reports documented employment areas on and adjacent to the airport. These areas were labelled by the Bay Area Transportation Study Commission (BATSC) as zones 61 and 66. Zone 61 corresponds to census tract 003 and zone 66 includes census tracts 024, 029, and 033 all in San Mateo County.

Table 2-19 lists the expected changes in "basic employment" between 1965 when the airport had 8.7 million total annual passengers and 1985 with 31.0 million annual passengers. The "basic industries" were determined in the previously cited reports and are defined later in this report.

Table 2-19 shows that of the 24,139 total basic employee increase, 13,655 in the Air Transportation, Hotel, and Federal Government categories are due only to air passenger growth.

No attempt has been made to establish the number of secondary "employees" that will result. These employees would be primarily in the service industries such as housing, insurance, commercial stores, etc. The "secondary employee" category would tend to be employed in areas where the "basic industries" employees spend their money.

Each "basic industry" that has shown significant economic relationships with the air transportation industry was evaluated on the basis of the following criteria:

- The dollar volume of transactions interchanged with the air transportation industry

Table 2-19

FUTURE BASIC EMPLOYMENT CHANGES — SAN FRANCISCO INTERNATIONAL AIRPORT

	Zone 61			Zone 66			Total Zones 61/66		
	1965	Change	1985	1965	Change	1985	1965	Change	1985
Basic Employment (number of employees)									
Air transportation	0	0	0	14,140	12,061	26,201	14,140	12,061	26,201
Hotels	110	1,214	1,324	347	0	347	457	1,214	1,671
Federal government	36	390	426	897	0	897	933	390	1,323
Wholesale trade	3,786	3,156	6,942	2,525	0	2,525	6,311	3,156	9,467
Other basic	8,307	3,755	12,062	4,158	3,563	7,721	12,465	7,318	19,783
	12,239	8,515	20,754	22,067	15,624	37,691	34,306	24,139	58,445

Note: Annual passengers enplaned and deplaned at SFO in 1985 = 31,000,000

- The relative concentration of the industry around San Francisco International Airport in 1965 based on BATSC survey results[16]
- The logical association of the industry with the near-airport location requirement

From this analysis, four "basic industry" categories were selected as being significantly influenced by the near-airport location feature. These industries, together with their two-digit Standard Industrial Classification (SIC) numbers as assigned by BATSC, are as follows:

Industry	SIC Number
Transportation by air	45
Hotels and other lodging places	70
Federal government	91
Wholesale trade	50

16 Unpublished tabulations of employment by two-digit SIC number in each BATSC Map Zone from the 1965 BATSC survey.

The air transportation industry is by far the most important of the four, rating very high under all three criteria. The hotel industry is becoming increasingly important around major airports. The federal government is primarily the FAA. The wholesale trade industries locate near transportation facilities generally and only certain segments of wholesale trade are heavy users of suppliers for air transportation.

Some industries were not included in the above tabulation. The petroleum industry (SIC number 29) was omitted even though it is a relatively important supplier to the air transportation industry. Most of the "basic" part of the petroleum industry in the Bay Area is located in Contra Costa County where the large petroleum refineries have good harbor access for their tankers on the northeastern part of San Francisco Bay. There is very little employment in this industry located near the commercial airports of the region even though commercial aircraft are important petroleum consumers. Aircraft fueling is done primarily by airline employees, who are included in the air transportation employment category. There is no reason to expect that airport location or activity levels will significantly affect petroleum industry location in the future.

The transportation equipment industry (SIC number 45), which includes aircraft, aero engines, parts, etc., was also omitted. Prime manufacturers of commercial aircraft generally locate on or adjacent to airports (although not necessarily major commercial airports). Subcontractors will often locate around these prime industries. However, there are no prime commercial aircraft manufacturers located in the Bay Area and there is no good reason to expect a prime aircraft manufacturer to move into the region in the foreseeable future. It should be noted, however, that aerospace-oriented companies and other research and development firms are generally heavy users of air transportation and are often motivated to locate their facilities around major commercial airports.

These types of companies are represented in a large number of industry categories, however, which makes them difficult to identify from a two-digit SIC industry breakdown.

The state government is a significant user of air transportation, but this industry was also not included. State offices in the Bay Area are primarily located within the central business districts (primarily downtown San Francisco). Most state aviation regulatory groups and agencies are located in Sacramento. No change in these patterns in the future is expected.

It has been assumed that air transportation employment around airports is a direct function of the passenger traffic levels at those airports.

During the base year, 1965, there was only one major commercial airport in the Bay Area — San Francisco International. In 1965 there were 14,140 air transportation employees at or around the San Francisco Airport. Virtually all of these were located within BATSC Map Zone 66. Of this total about 6,000 were employed at United Air Lines' jet maintenance base located at the San Francisco Airport. The remaining 8,140 were directly associated with activity at the airport. With 8.7 million passengers enplaned and deplaned at San Francisco International in 1965, a ratio of 1,069 passengers per employee results:

$$\frac{8,700,000}{8,140} = 1,069$$

As with most highly mechanized industries, air transportation employees are becoming more productive over time. There is an average annual increase in passengers per employee of about 4.7 percent per year. It is assumed that this is a normal rate of employee productivity increase

which will continue in the future. Thus, by 1985, for example, air transportation employees at San Francisco International Airport will service about 2,672 annual airport passengers per employee, resulting in a total of 26,201 employees for 31 million annual passengers.

The same general method was used to project future employment levels at United's jet maintenance base. However, because this facility is used to service United's total system operations, the relationship was established between these employees and the total passengers on United's system. In 1965 United enplaned and deplaned about 34.4 million passengers for their total system. This means that the 6,000 employees at their jet maintenance base in San Francisco served about 5,731 United passengers per employee. Again, assuming normal industry productivity increase, this figure would increase by about 4.7 percent per year. Thus, by 1985, United's maintenance base employees will be able to serve about 14,330 system airline passengers per employee.

Hotel employment is generally a function of the number of hotel rooms available. A full-service hotel will employ about one person for every 3.5 rooms. This ratio has not and is not expected to change substantially. Hotel rooms around San Francisco International Airport exist at a rate of about 1,000 rooms for every 5 to 5.5 million enplaned and deplaned passengers. The assumption is that future hotel expansion will take place at a rate of about 1,000 rooms per 5.3 million passengers. This results in about 54 hotel employees per one million airline passengers, or 1,671 hotel employees when the airport reaches 31 million annual passengers.

Federal employees associated with the operations of a major commercial airport can be considered as a specialized group of air transportation employees. There were about 8.7 air transportation employees at San Francisco International Airport in 1965 for every federal employee in the

airport area. It is assumed that this ratio of one federal employee for every 8.7 air transportation employees will continue in the future, resulting in 1,323 federal employees.

It is difficult to establish meaningful relationships between the wholesale trade industry and airport traffic levels. Segments of this industry are important suppliers to air transportation and other segments are important air transportation users (particularly of air cargo service). Still other segments of the industry locate around airports because of the availability of other modes of transportation. As traffic grows around an airport, certain segments of the wholesale trade industry located there would expand. On the other hand, expansion of other types of industry around the major airports will create increasing land values and surface transportation congestion conditions, which will tend to deter the growth of some segments of the wholesale trade industry. For these reasons, it has been assumed that, as a group, the wholesale trade establishments now located around the major airport sites will grow at about the same rate as projected for this industry in the region as a whole.

The area around each major airport will contain categories of "basic employment" other than those associated with the four industries above. For example, in 1965 about 36 percent of the "basic employment" in Map Zones 61 and 66 around San Francisco International was in other "basic industries." No one industry other than the four discussed above appears singularly significant. However, it is reasonable to assume that as a general rule these employees represent companies that for various reasons find it advantageous to be located in the general vicinity of the airport. It has been assumed that employment in each of these "other basic industries" located in the area around a major airport will grow at the same rate as that projected for each specific industry in the region as a whole. The regional industry growth rates represented by these data

are applied to the base year employment levels of each industry located in a particular airport's area to calculate the "other basic industry" employment for that area during any future time period.

The figures in Table 2-19 are slightly lower than shown in the previously cited reports. This is because employment figures were reduced in the air transportation, hotel, and federal employee categories to reflect 31 million annual passengers in 1985 instead of 32.65 million annual passengers used in the reports.

No set standard has been rigorously adhered to in determining the acreage required to accommodate "basic industry" growth around major airport sites in the future. Generally, basic industry land requirements range between 10 and 20 employees per acre in the Bay Area depending upon the specific industry involved and the general intensity of land usage in the specific area of the region being considered. For example, the amount of usable industrial acreage available in the area around San Francisco Airport is becoming relatively scarce so that future development in this area will warrant more intensive land usage than would be true in less urbanized areas of the region. It is assumed that all air transportation employees at a given airport will be employed on the airport property itself. Thus, at San Francisco Airport, where the land available for expansion is limited, future employment densities on the airport property (exclusive of land requirements for runways, taxiways, etc.) may run as high as 50 to 55 employees per acre in the future.

Hotels also represent a higher intensity land use than most "basic industries" being considered. It has been assumed that hotel acreage requirements will be about 90 rooms per acre in any of the major airport areas. Where land is available for development, it has been assumed that air transportation, federal government, and wholesale trade will develop at

an intensity of about 10 employees per acre. Other "basic industries" locating around the major airports will develop at a higher intensity of about 20 employees per acre. From these assumptions, all the usable vacant land existing in 1965 in zones 61 and 66 will be utilized by 1985.

m. UTILITY SERVICES CHANGES

Water

The total airport utilized 1.95 million gallons of water per day in 1968-1969. This figure is expected to increase to 5 million gallons of water per day with a peak day demand of 7.5 million gallons. The airport utilized 2.4 percent of the total demand of 82.5 million gallons of water used per day by San Mateo County in 1970. The airport water demand is expected to be 4.7 percent of the total water demand in 1985.

Sewage

The airport has a separate system for handling sewage. Industrial wastes and storm water flows are a separate system. The airport completed a new 2.2-million-gallons-per-day sewage treatment plant in March 1972, including the necessary influent and effluent lines and utility connections. A deep-water sanitary outfall is budgeted to provide a more effective means to comply with federal water quality standards. The airport has a daily monitoring system to report effluent quality and ensure that the effluent meets water quality standards.

Industrial Waste Disposal

The airport generates industrial liquid wastes from airplane cleaning maintenance operations and from motor vehicles. These operations are

at many separate locations on the airport. The United Air Lines maintenance base is a major industrial liquid waste contributor. United pretreats its waste before draining it to the airport storm drain system. Occasional fuel spills also contribute. The industrial wastes discharge into the storm drain system. During dry weather the industrial waste flow drains to two oxidation ponds for treatment prior to being pumped into San Francisco Bay. During wet weather, industrial wastes are diluted with storm water and flow directly into the Bay. The industrial wastes effluent is sampled each month and is reported to the Water Quality Control Board.

The Expansion Program includes budget items for an industrial waste treatment plant, force mains, and pump stations. The plant will treat industrial wastewater and will be designed to produce an effluent that meets future standards of the Water Quality Control Board. The net effect will be to provide an improvement by 1985 over existing conditions. The airport is required by law to meet whatever water quality standards are set by the Water Quality Control Board. The water quality standards for 1985 have not been completely defined to date.

Storm Drains

The drainage system at San Francisco International Airport removes stormwater from runways, taxiways, and other paved and roofed areas and limits storm water flooding in unpaved areas. The drainage system is a series of pipelines and canals that carry the storm water to the Bay. Most of the system drains to the two detention basins described in the industrial waste disposal system. A small part of the system near the ends of runways 19 and 28 drain directly into the Bay. The expansion program envisions some additions to the drainage system by a series of pumps and related facilities to enable the system to operate better at high

tides. Paving of present unpaved areas will result in some of the storm water reaching the Bay faster. Unpaved areas allow the water to seep into the ground and travel slowly to the Bay. The total effect is to change the time when storm water enters the Bay, but not the amount.

Natural Gas

Natural gas is distributed to San Francisco International Airport by the Pacific Gas and Electric Company (PG&E). The average winter gas use in 1969 was 500,000 cubic feet per hour. The 1985 demand is expected to be approximately 1,300,000 cubic feet per hour. Existing supply lines to the airport can supply the increased rates.

Aviation Fuel

The number of annual airline operations is expected to decline slightly from 333,000 in 1969-1970 to 310,000 operations in 1985. This reduction is due to the larger separation between aircraft required because of air turbulence created by large jets. This lesser number of aircraft will require more aviation fuel because of the larger average size of aircraft in 1985. The demand in 1970 was 670 million gallons of fuel per year. This is expected to increase to 2,250 million gallons per year by 1985.

Aviation fuel is delivered to the airport now either by underground fuel lines or by barge to a dock on the north side of the airport. The fuel is held in storage areas and then pumped by underground fuel lines to fuel hydrants at aircraft parking positions. The barging operation is an interim procedure that is used now because of slide damage to one fuel line in Oakland. When the fuel line is repaired, the barging of fuel will become an emergency procedure. The filling of the seaplane harbor will require relocation of the existing fueling dock.

The filling of the seaplane harbor will be covered by a separate environmental impact statement. The seaplane harbor fill statement will investigate all expected impacts and include water quality changes, recreational improvements, fish and wildlife changes and navigable water changes as well as the relocation of the fuel dock.

Solid Waste Disposal

Solid wastes are generated at San Francisco International Airport. The characteristics of weight and composition for the four major sources on the airport are:[17]

	Weight (tons per week)	Primary composition type
Passenger terminals	68.7	70 percent paper
Air freight area	29.8	46 percent paper 17 percent wood 10 percent plastics
Aircraft service centers	133.2	34 percent food 32 percent paper 12 percent metal 10 percent plastics
United Air Lines aircraft maintenance base	55.6	51 percent paper 15 percent food 10 percent plastics
Total	287.3	

Demolition material, normally generated in large quantities at an airport complex, was not generated during the sampling period and therefore could not be measured.

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17 Metcalf and Eddy, Analysis of Airport Solid Wastes and Collection Systems, San Francisco International Airport, March 1972

The unit generation values derived for each source are:

Passenger terminals	0.53 pound per passenger
Air freight area	7.10 pounds per ton of cargo
Aircraft service centers:	
Composite of all activities	1.02 pounds per passenger
Aircraft flights including meal service wastes	2.51 pounds per passenger
Aircraft flights excluding meal service wastes	0.54 pound per passenger
Aircraft maintenance base	2.19 pounds per employee per day

The major solid-waste generator is the aircraft service center, which includes both hangar wastes and aircraft passenger wastes. The most significant waste is from aircraft flights serving meals.

The total quantity of refuse generated at San Francisco International Airport is 287 tons per week. This quantity is projected to increase to 500 tons per week by 1985.

Existing solid-waste systems are controlled individually by each airport tenant, except in the terminals where the airport authority controls the system. A single hauler serves all tenants on the airport. The hauler removes all wastes from the airport for disposal at a county sanitary landfill located about 15 miles from the complex.

Demolition material is hauled in debris boxes or standard earthwork construction vehicles (dump trucks). Wood wastes, normally placed in debris

boxes, are disposed of off the airport at the sanitary landfill. Dirt, broken concrete, and broken asphalt pavement are disposed of on the airport in areas where the existing land has subsided and benefits from filling.

Solid wastes from the airport and most other areas of San Mateo County are disposed of at the San Mateo County sanitary landfill. When the County develops new methods or areas of disposing of solid wastes, the airport will be one of many customers participating in the change.

Electrical Load

The airport is located adjacent to the Pacific Gas and Electric transmission corridor that serves the greater-San Francisco area. This transmission corridor contains four 115-kv transmission lines. The airport is served by three 12-kv feeders from two different substations. All three feeders serving the airport are "clean" with no other loads connected. From a system reliability standpoint, the PG&E system in the San Francisco area is considered to be on par with other major systems in the United States.

Total airport electrical load (excluding the United Air Lines Maintenance Base) in 1971 was 18.0 million volt amperes (mva). This is expected to increase to 62.8 mva by 1978 and is ultimately expected to grow to 90.0 mva.[18]

The existing PG&E substations have an ultimate capacity of 90.0 mva when all the necessary equipment is installed.

The ultimate connected load will be five times the 1971 connected load.

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18 R. W. Beck and Associates, Master Utilities Plan and Electrical System Study at San Francisco International Airport, May 1972

n. GROUND TRANSPORTATION TO SAN FRANCISCO INTERNATIONAL AIRPORT

San Francisco International Airport is on the east side of the San Francisco peninsula, some 14 miles south of the city's central business district. It is in San Mateo County near the cities of San Bruno and Millbrae. Its location in relationship to access facilities is shown in Figure 2-10.

The principal approach route from the north or south is the Bayshore Freeway (U. S. 101). A directional-type interchange gives exclusive access to the airport, whose main terminal is one-half mile east of the freeway. U. S. 101 is convenient to all major population centers on the San Francisco peninsula, but due to increasing pressure of other traffic will not give a high level of service to the airport indefinitely.

There are also secondary external links to the airport. San Bruno Avenue interchanges with Bayshore Freeway about 1.5 miles north of the main airport access road, and provides a crossing that links to Airport Boulevard north of the main terminal area. These two roads provide direct access to the United Airlines Maintenance Base, and allow indirect access to the passenger terminal area via the frontage road along Bayshore Freeway. Millbrae Avenue and Bayshore Highway both interchange with Bayshore Freeway south of the airport; they intersect just east of the freeway and also allow indirect access to the terminal area via the freeway frontage road.

Although there is a Southern Pacific Company rail line which serves commuters along the peninsula, it does not serve the airport effectively since there is no service to the airport. It is located west of the Bayshore Freeway from the airport.

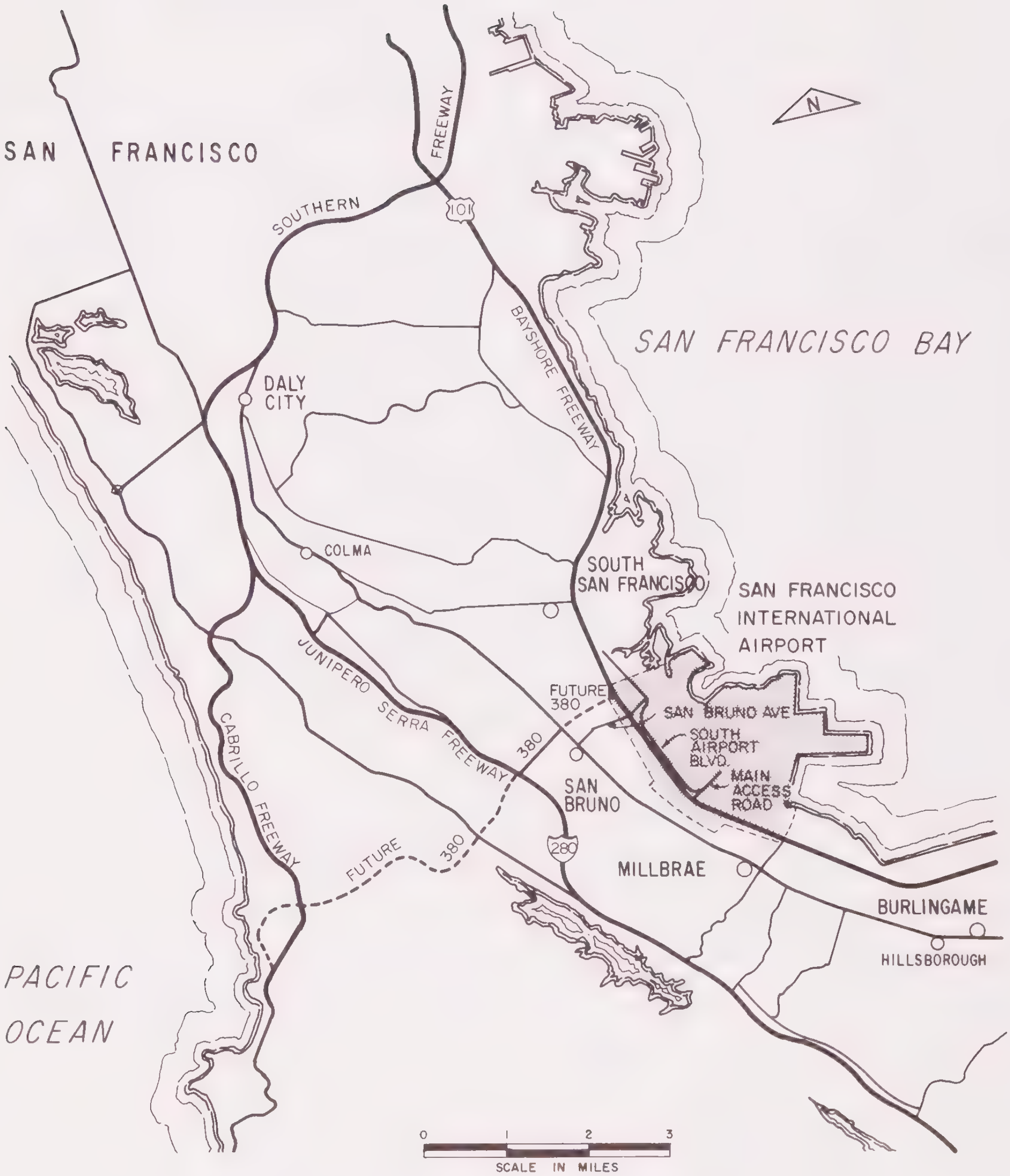

Figure 2-10. Regional Access Plan, San Francisco International Airport

By 1978, a new freeway, designated Interstate Route 380, is scheduled for completion. This will connect with the Bayshore Freeway at the San Bruno Avenue interchange and will extend westerly to an interchange with the Junipero Serra Freeway (I-280).

In conjunction with the I-380 project, the Bayshore Freeway will be reconstructed and expanded from the airport interchange north to the I-380 interchange. The 1978 capacity will be 10,000 vehicles in each direction during the peak hours. South of the airport interchange, the capacity of the Bayshore Freeway is not expected to change.

San Bruno Avenue is a major four-lane street which serves the United Airlines Maintenance Base near the northern boundary of the airport property. It is an east-west route that connects with the Bayshore Freeway as well as other north-south arteries. Its present capacity is 2,200 vehicles per hour in each direction. When the planned interchange with I-380 is completed, the road will be reconstructed between the freeway and the Maintenance Base. It will then be a six-lane expressway with an hourly capacity of 3,600 vehicles in each direction.

The main access road between Bayshore Freeway and the passenger terminals is in the final stages of reconstruction, improving the previous four-lane roadway with intersections at grade to a limited-access expressway of ten lanes. Basic capacities of 2,200 vehicles per hour (one-way) and 55,000 vehicles per day (two-way) will increase to 5,500 and 140,000, respectively. These capacities are summarized in Table 2-20.

The critical areas are the single-lane ramp connections in all four directions at U.S. 101 and the section near the terminal that requires complex weaving or unbalanced loading of the right-hand lanes to reach any of the numerous exit roadways to the different parking levels and loading curbs. Capacity of each ramp is 1,300 vehicles per hour, giving a possible total

Table 2-20

CAPACITIES OF ACCESS ROUTES TO
SAN FRANCISCO INTERNATIONAL AIRPORT

Facility	Type	Hourly Capacity[a] (one-way)	Estimated 24-Hr Capacity (two-way)
Bayshore Freeway[b] (Route 101)	8-lane freeway	6,600 vehicles	160,000 vehicles[c]
Bayshore Freeway from San Bruno Ave. to airport interchange, after 1975	Multilane freeway complex	10,000 vehicles	250,000 vehicles
Main access road, prior to 1970	4-lane expressway	2,200 vehicles	55,000 vehicles
Main access road, 1973+	10-lane expressway	5,500 vehicles	140,000 vehicles

[a] Capacity based on level of service "D."

[b] Applies to freeway both north and south of the airport interchange.

[c] Average daily traffic in the peak month during 1969 was 155,000 vehicles.

of 2,600 vehicles in or out per hour, assuming equal volumes to the north and south. By 1978, interchange improvements will increase this capacity to 3,000 vehicles per hour on each ramp.

The public parking available at San Francisco International Airport in 1972 and the projected parking in 1975 are listed below.

	Number of Spaces	
	1972	1975
Airport Garage	3,110	7,300
Parking Lot No. 1	630	—
Parking Lot B	569	—
Remote Parking	910	1,410
Total	5,219	8,710

Current plans, while in a state of flux, indicate that by 1975 the garage will be expanded to a capacity of 7,300 spaces and will incorporate Lot No. 1 The total public parking will then be 8,710 spaces, if some of this space is not lost either to rental car storage or a transit terminal. Other available airport parking is as follows:

	Number of Spaces
Employee Parking	
Near Pam Am Hangar	870
Near TWA Hangar	350
Near United Hangars	900
Large North Lot (general)	700
Large South Lot (general)	240
Near Present Cargo Buildings	600
Near Pacific Hangar	150
Near Post Office Facility	200
Near American Hangar	150
Near United Maintenance Base	3,000
Near Coast Guard Station	100
	(+500 not in use)
Total	7,760 spaces
Rental Car Storage	300
Official Cars and Other	
(large lots west of Bank of America)	230
Grand Total	17,000 spaces

(In addition, 400 spaces for the Hilton Inn patrons and employees and approximately 200 truck-loading docks exist at the airport. A remote, privately operated parking lot with shuttle bus service to the airport terminal began operating in 1970.)

The main access road makes a large loop around the parking structure, its outer perimeter skirting the two passenger terminal buildings, as shown in Figure 2-11. The loop is separated into two roadways at different levels, the upper one at the level of enplaning terminal operations and the lower one at the level where deplaning passengers collect their baggage.

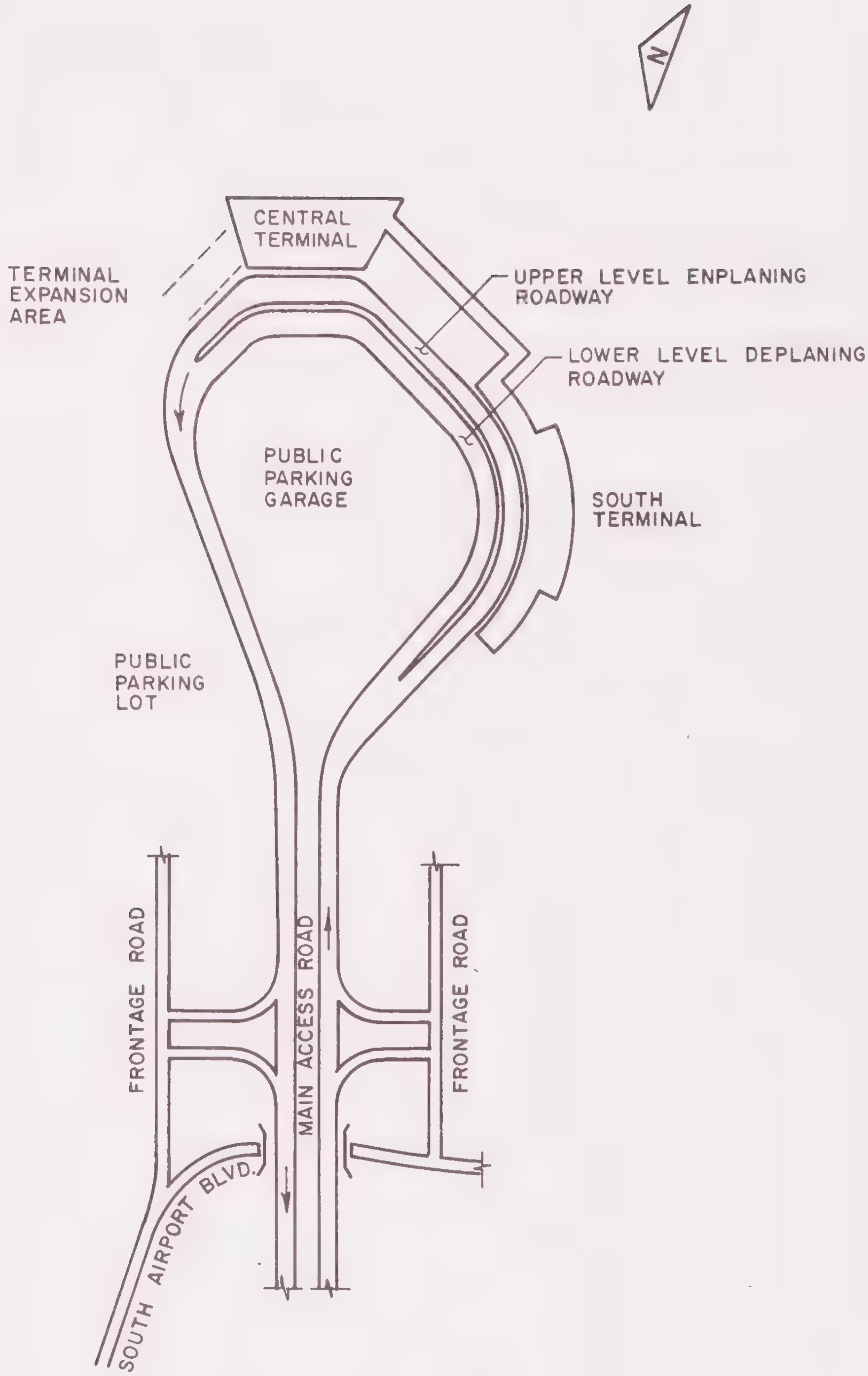

Figure 2-11. Airport Terminal Layout, San Francisco International Airport

The layout does not encourage drivers to perform a curb dropoff and then park in the structure. The minimum distance from the loading curb to the garage entrance is about one-half mile, and it is necessary to weave across three traffic streams entering the circulation loop road from the left before making the required left turn at a grade intersection.

The curb space available for passenger pickup and setdown (measured in linear feet) is as follows:

	Enplaning	Deplaning
Total at South Terminal	800	800
Total at Central Terminal	800	800
Total linear feet of curb space for auto passenger pickup and setdown	1,600	1,600

Due to the random fluctuations in stopping times and in airline demand, observations suggest that 70-percent utilization can be considered as practical capacity. (It is usually desirable to utilize curb frontage that is convenient to the processing centers of the various airline companies.) Present hourly capacity is thus 66,500 foot-minutes for enplaning passengers and 66,500 foot-minutes for deplaning passengers.

Average stopping times vary with the type of vehicle. For the purposes of determining a capacity in terms of vehicles per hour, an assumption must be made as to the percentage of private automobiles, taxis, hotel limousines, and buses. Table 2-21 summarizes the capacities.

Plans are now being prepared for the construction of the new North Terminal, which will add 800 linear feet of usable curb space to both the enplaning and deplaning roadways. Eventually, the two plaza areas between the three terminals will be enclosed so that a continuous structure will

Table 2-21

1968 HOURLY CURB CAPACITIES FOR
ENPLANING AND DEPLANING PASSENGERS —
SAN FRANCISCO INTERNATIONAL AIRPORT

Type of Vehicle	Ft-Min Available	Avg. Ft-Min Per Vehicle	Allowable No. Of Vehicles Per Hour	Avg. Air Pass. Per Vehicle	Enplaning Air Pass. Per Hour
Enplaning					
Auto	45,600	50	912	1.3	1,186
Taxi	8,200	30	273	1.7	464
Hotel Limousine	5,500	105	52[a]	2.0[a]	104
Bus	7,200	110	65[a]	8.0[a]	520
	66,500				2,274[b]
Deplaning					
Auto	43,800	75	584	1.3	759
Taxi	8,800	50	176	1.7	299
Hotel Limousine	4,700	140	33[a]	2.0[a]	66
Bus	9,200	220	42[a]	12.0[a]	504
	66,500				1,628[b]

[a] Limousines and buses normally make two or three stops on the terminal roadways at SFO. The number of air passengers per vehicle is therefore the average number disembarking at each stop. Each stop made is counted as a separate vehicle for computational purposes.

[b] The airport capacity is more than these figures because many autos never use curb space, but use only the parking lots or auto rental areas.

be formed. The usable curb space will then be approximately 3,200 linear feet for each of the roadways.

If the curb usage characteristics will remain essentially constant, the projected peak hour passenger discharge and pickup capacity of the curb space will increase from the current 3,900 to 7,800 linear feet in 1985, as follows:

	1968	1975	1985
Enplaning curb space (feet)	1,600	2,400	3,200
Peak-hour enplaning passenger capacity	2,275	3,400	4,550
Deplaning curb space (feet)	1,600	2,400	3,200
Peak-hour deplaning passenger capacity	1,625	2,450	3,250
Total peak-hour passenger capacity[a]	3,900	5,850	7,800

[a] In this case, "passengers" means the maximum practical number of air passengers utilizing vehicles at the curb frontage for access to and from the terminals. It does not include those using other means of access, such as the parking garage, car rentals, etc.

These figures indicate that curb space for air passengers will double. Potential curb space users will increase by 83 percent by 1985, indicating that the curbs will not be as heavily used in 1985 as in 1970. This is attributed to approximately 30 percent of the airline passengers' using rapid transit (BART) in 1985 as opposed to 15 percent using bus transit in 1968.

A report entitled Route Location, Airport and Approach, San Francisco Airport Access Project by Parsons, Brinkerhoff, Tudor, Bechtel, Wilbur Smith, Kirker, Chapman, March 1971, described studies made

to extend BART facilities to the airport. A total of 20 schemes were investigated to determine the best method of serving the airport. The recommended scheme is a subway through the airport because it is aesthetically more pleasing than an aerial scheme and it will offer better transit service. Provisions are being made in the airport expansion program to physically accept BART when it is constructed. The report indicated that if BART were extended from Daly City through the airport to San Jose, 70,000 air-passenger-related trips might be expected after 1985 on a busy peak day. This could be a substantial diversion of air passengers from autos, but would be a small portion of the capacity of the BART line.

Although transit has been included as part of the ground transportation system for the airport, the major focus is on highway access because it is there that the problems of access capacity restraints appear most likely to occur.

Ground access demand for San Francisco International Airport was determined directly from the air-passenger capacity figures used after deducting transferring passengers. The figures were first of all split by mode to give highway and transit ground transportation trips by air passengers for an average day in 1985 (i.e., the yearly total divided by 365). Air-passenger and air-passenger-related auto trips were then computed using suitable factors. To the air-passenger and air-passenger-related trips were added those made by employees and other nonair passengers traveling to or from the airport. The number of employee and other trips is generally found to be a function of the number of air passengers using an airport, and estimates were therefore derived from the appropriate air passenger figures.

To compare ground access demand with the existing and proposed highway access capacity, a peak day rather than an average day was used. In the BASAR Aviation Demand Report it was estimated that the highest month (August) will carry 11.7 percent of the annual air travel demand in 1985. Studies have shown that volumes on a Friday exceed those of an average day of the week by about 25 percent. Thus, ground access demand for air travel on a Friday in August is approximately 50 percent higher than on an average day of the year.

Likewise, employee trips are not equally distributed over the 365 days of the year. Whereas work trips are relatively constant throughout the week, there is a considerable decrease over the weekend. It can be shown that the number of work trips for an average weekday is represented by dividing the annual total by 300. For business and other non-air passenger trips it was assumed that there is very little significant variation either from month to month or from day to day.

Airport ground access traffic peaks between 4:00 and 5:00 P.M. when about 10 percent of the daily trips occur. In accordance with the Highway Capacity Manual, calculation of existing or proposed highway access capacity was based on the following hourly lane capacities at level of service "D":

Freeway or expressway	1,500 vph[a] per lane
Multilane arterial with access control	1,200 vph per lane
Multilane arterial without access control	1,000 vph per lane
Two-lane highway	1,500 vph both directions

[a] Vehicles per hour

In Table 2-22 the 1985 highway access demand at each airport for a peak day in 1985 (August, Friday) is compared with the proposed capacity

Table 2-22

HIGHWAY ACCESS DEMAND VERSUS CAPACITY — SAN FRANCISCO INTERNATIONAL AIRPORT

Annual Airport Capacity (millions of passengers)	Peak Day Ground Access Demand (vehicles/day)	Proposed or Existing 24-hour Access Capacity (vehicles/day)	Type of Proposed or Existing Highway Access
31.0	166,400[a]	198,000	10-lane expressway (main access) + 4-lane arterial (Airport Blvd.)

[a] Wilbur Smith & Assoc., Airport Access, Phase II, RASS, Sept. 1971, listed 171,740 vehicles per day for 32.7 million annual passengers. This figure was reduced to 166,400 vehicles per day to correspond to 31 million annual passengers.

of its access facilities. Where no information was available regarding the future access facilities, the demand is compared with the existing capacity. This table indicates that after all the road improvements are constructed by the airport and State Division of Highways, vehicle access demand will be below maximum capacity of the roads on and around the airport.

o. GROWTH-INDUCING IMPACT

The proposed expansion program is to provide the facilities for air transportation as demanded by the flying public. An airport is a public facility, provided to fill an existing or projected public need. If provided in advance of need, the facilities remove potential obstacles to growth; if provided only after the need becomes urgent, the lack of facilities inhibits growth and causes irritation and injustice. It follows that the timing of public facilities is most important.

The employment section of this report indicated an increase of 24,139 basic industries employees by 1985. Of this increase, 13,655 would be attributable to air passenger growth, with the other portion due to a general increase in basic employment by industries that locate around the airport. This basic industries employment increase is expected to cause increases in "population-serving" industries such as banks, restaurants, insurance, retail sales, etc. The exact magnitude of this population-serving growth due to growth in airport basic employment has not been estimated. However, the report Economic and Spatial Impact of Alternative Airport Locations indicates that in 1980 for the larger counties in the Bay Area, there will be 1.25 population-serving employees for each basic employee. If this ratio holds true for later years, the 13,655 basic employees would create employment for 17,100 population-serving employees. This 30,755 total increase would be 11.2 percent of the projected 260,000[19] employment in San Mateo County in 1985, and 1.2 percent of the nine-county projected 2,473,000 employment in 1985.

[19] Gillfillan, op. cit.

SECTION THREE

Section 3

PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

One environmental effect which cannot be avoided is the increase in vehicle traffic on the airport and on the roads leading to the airport. This increase will take place even though facilities for BART are included in the expansion program.

An increase in the solid and liquid wastes generated is unavoidable. This increase has been anticipated in the design of the sewage-treatment plant and will be incorporated in the industrial waste-treatment plant.

The increase in water, natural gas, electricity, and aviation fuel is unavoidable because these are necessary ingredients for accommodating increased passengers.

SECTION FOUR

Section 4

MITIGATION MEASURES TO MINIMIZE IMPACT

The following measures will be taken to minimize the environmental impact of the proposed expansion program:

- The development will take place within existing airport boundaries. No land acquisition or displacing of people is programmed.
- Noise from aircraft will be reduced. The existing program of takeoffs and landings over water when weather conditions permit will be continued. Introduction of larger aircraft with quieter engines will aid in reducing noise levels.
- The quality of water entering the bay from the airport will be improved because of more complete treatment of sewage, construction of an industrial wastewater treatment plant, and the construction of a deep water outfall.
- Provisions for Bay Area Rapid Transit (BART) are being incorporated in the construction plans. If BART is extended to the Airport, it is expected to reduce reliance on the automobile and hence reduce the amount of automobile congestion and air pollution. In addition, BART is planned to be placed underground through the airport so there will not be an adverse visual effect.
- Air quality is expected to be improved. Additional parking and roadways are expected to reduce traffic congestion and hence automobiles engines will be used less by idling in traffic congestion or hunting for parking or curb space. Cleaner engines required by California law will also reduce air pollution, even though there will be more automobiles on the airport.

SECTION FIVE

Section 5

ALTERNATIVES TO THE PROPOSED DEVELOPMENT

The alternatives to the proposed development include:

1. Do nothing
2. Expand other airports in the Bay Area
3. Construct a new airport

The following alternatives were investigated in some detail by the Regional Airport Systems Study.

Alternative No.	Airport	Future Annual Airport Passengers Enplaned and Deplaned (millions)
1	SFO	32.650
	Oakland	34.314
	San Jose	16.500
		83.464
2	SFO	37.884
	Oakland	24.100
	San Jose E (new)	21.480
		83.464
3	SFO	32.650
	Oakland	13.780
	Hollister (new airport)	30.774
	Hamilton Air Force Base	2.678
	Buchanan Field	2.392
	Livermore Airport	1.190
		83.464

4	SFO	32.650
	Oakland	13.780
	San Jose	7.500
	Travis Air Force Base	29.534
		83.464
5	SFO	37.884
	Oakland	22.007
	San Jose	16.500
	Sonoma County Airport	2.678
	Richmond (new airport)	4.395
		83.464
6	SFO	32.650
	Oakland	17.000
	San Jose E (new)	33.814
		83.464
7	SFO	32.650
	Oakland	8.814
	San Jose E (new)	42.000
		83.464
8	SFO	32.650
	Oakland	13.780
	San Jose	7.500
	Napa County Airport	2.689
	Hollister (new airport)	26.845
		83.464
9	SFO	32.650
	Oakland	43.314
	San Jose	7.500
		83.464
10	SFO	32.650
	Oakland	24.100
	San Jose	16.500
	Napa County Airport	10.214
		83.464
11	SFO	32.650
	Oakland	13.780
	San Jose	7.500
		53.930

In addition, the following alternatives were considered:

12 A regional mid-Bay airport with BART connections to replace SFO and Oakland. This new airport would have two sets of parallel 12,000-foot runways over 2,000 acres of fill. The intention is to relieve noise impact, improve retail accessibility, and replace separate SFO and Oakland Bay fill. SFO and Oakland would be used for parking and terminal functions.

13 A new regional airport in eastern Contra Costa County

14 A new airport in southern Sonoma County (North Bay)

After the reports were published, a number of public meetings were held. The meetings established that the public did not want new airport sites created because of environmental considerations. This eliminated Site E, North Bay, and mid-Bay. The eastern Contra Costa County site was eliminated because of the average one-way trip distance of 70 miles.

After considering all of these alternatives, the Regional Airport Systems Study recommended that the airports in the Bay Area be developed to the following annual capacities:

SFO	31 million
Oakland	24 million
San Jose	10 million
Travis Air Force Base	6 million
Hamilton/Napa	1 million
Total	72 million

The Regional Airport Systems Study also considered the concepts of Short Takeoff and Landing (STOL) aircraft and a high-speed rail service between San Francisco and Los Angeles. While these systems may show great promise, they are not yet economically and operationally viable and

and are not expected to be operational before 1985. These systems may, however, lower the total demand for air travel by the year 2000 from about 240 million to 150 million annual passengers.

SECTION SIX

Section 6

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The expansion program will take place within the existing airport boundaries. No land acquisition for the expansion program is envisioned. By the use of vehicles that pollute less and aircraft that are not as noisy, the environment is generally improved. This better use of the environment is expected to continue after 1985 as mankind better understands how to solve these environmental problems. The airport expansion provides for a more efficient (in terms of speed) transportation system.

SECTION SEVEN

Section 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WILL RESULT

Implementation of the expansion program will require the expenditure of the following resources:

- Construction material for buildings and pavement
- Construction material for building furnishings
- Energy supplies for heating and cooling buildings
- Manpower for construction
- Money for construction

SECTION EIGHT

Section 8

PROBLEMS AND OBJECTIONS RAISED BY FEDERAL AGENCIES AND STATE AND LOCAL ENTITIES

A comprehensive review of the reports prepared by ABAG was performed by the Air Transport Association (ATA). Most of the domestic airlines belong to the ATA. The following is a summary of the comments:

- Data used in estimating the amount of pollutants produced by aircraft may be high, causing an overstatement of the expected pollutant emissions.
- The NEF noise contours are calculated quantities, with many assumptions. A comprehensive community noise measurement should be accomplished to verify the reliability of the noise contour locations.
- Passenger forecasts are too high. The ATA forecasts 59 million annual passengers in the Bay Area in 1985, and assumes that SFO will reach capacity and then the passengers will "spill over" to Oakland and San Jose.

The higher emission rate used may cause an overstatement of the actual pollutants emitted. To this degree then, the calculated emissions are conservative (high).

San Francisco International Airport is in the process of setting up a noise-monitoring system in the community to comply with new California noise laws.

If the actual number of passengers in the Bay Area in 1985 is 59 million, as forecast by the ATA, instead of 72 million, and if San Francisco Airport is filled to capacity before Oakland and San Jose are expanded, San Francisco may reach 31 million annual passengers before 1985.

A second problem may occur. New California noise regulations stipulate that by 1985 no residences are permitted within a CNEL 65 noise contour. The CNEL 65 contour is roughly equivalent to the 30 NEF contour. To comply with this new state law, the Final Plan Recommendation of the Regional Airport Systems Study concluded that CNEL noise criteria could be met if:

- Higher aircraft utilization than originally assumed allowed the same number of passengers to be carried in fewer flights.
- A reduction in the forecast also reduced the total number of flights required.
- A diversion of some civil flight operations to Travis and Hamilton AFB occurred. Existing noise impact from military traffic would not appear to be noticeably increased.
- Early retirement or engine retrofit of 727, 737, and DC-9 aircraft took place. The NEF forecasts for 1985 included a number of pre-Federal certification standard airplanes in the mix for which only a minor retrofit was assumed.
- No conversions of existing compatible land uses occurred.
- No construction of residential areas in lands that are now vacant in the present as well as future impact area occurred.
- Technology would allow the two-segment approach to be applied to all landing aircraft.

If all the above do not reduce the CNEL 65 sufficiently to exclude residences, then a drastic aircraft operations curtailment combined with a land acquisition program may be required.

SECTION NINE

Section 9

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APPENDIX A

APPENDIX A

INDIVIDUAL PROJECT DESCRIPTIONS WITH ENVIRONMENTAL IMPACT SYNOPSES

	PROJECT DESCRIPTION	ENVIRONMENTAL IMPACT SYNOPSIS
TERMINAL AREA PROJECTS — PHASE I		
North Terminal Complex		
T1	Demolition of Cargo Buildings 1, 2, 3, and 4 Demolition of existing cargo buildings located in the area in which the North Terminal facilities are to be constructed. Cargo Building 1 has been demolished; Cargo Buildings 2, 3, and 4 to be demolished according to the construction requirements of Boarding Area H and I and adjacent aprons. (25 percent complete — $300,000)	No significant impact. Will help provide an improved visual effect.
T2	North Terminal Foundations Construction of the 160,000-sq-ft basement structure, including first-level slab, for the foundation for the North Terminal, with utilities roughed in but excluding any finish work. (49 percent complete — $4,000,000)	No significant impact.
South Terminal Complex		
T10	Boarding Area A Construction of the 200-foot-diameter, three-level rotunda structure, partially enclosed at ground	Will provide for larger and quieter aircraft and improved visual effect.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
T10 cont.	level and fully enclosed at the second and third levels, finished in the public use areas, and including the first bay of the connector, and providing over 74,000 sq ft of enclosed space, with nonpublic areas completed to the extent prescribed by Airport Tenant Policy. Cogs have been added on the second level to meet airline requirements. (65 percent complete — $4,450,000)	
Ground Transportation Complex		
T26	Fifth-Level Addition to Existing Garage Construction of the 248,000-sq-ft fifth level on the existing terminal garage, providing about 600 additional parking spaces. (Complete — $1,967,305)	Improved capacity.
Ground Transportation Support Facilities		
T36	Entry Roads Including West Underpass Construction of new main entry roads and side service roads from Bayshore to the entrance to the terminal area, including construction of the West Underpass structure and a sewage lift station, and provision of utilities. (Complete — $3,008,025)	Improved capacity.
T37	Terminal Roads and East Underpass Construction of the two elevated three-lane roadways, the inner roadway running around the garage (except for the section in front of the garage) and the outer roadway consisting of an up-ramp to the South Terminal addition, replacement of the section between the South and	Improved capacity.

	PROJECT DESCRIPTION	ENVIRONMENTAL IMPACT SYNOPSIS
	East Terminals, and extension from the East Terminal past the projected North Terminal to and including the down-ramp; construction of the new East Underpass, paving of the lower terminal roads, and construction of six sewage lift stations, four pedestrian tunnel structures and pedestrian bridge foundations, and provision of utilities. (Complete — $10,904,219)	

AIRSIDE AREA PROJECTS — PHASE I

A1	Taxiway B and Apron Reconstruction of Taxiways B and A by moving out 100 feet between Taxiways M and D to provide additional apron required to accommodate the new generation of large jets. (Complete — $2,755,238)	Provides facilities for larger and quieter aircraft.
A2	Extension of Taxiway B and Apron Extension of the new Taxiway B (A1) west from Taxiway D to provide additional clearance for 747 aircraft to pass at United's existing Pier b. (Complete — $1,022,119)	Provides facilities for larger and quieter aircraft.
A3	Taxiways G and L Construction of Taxiway G and extension of Taxiway L to the south from G, providing a bypass taxiway to Runway 1R to eliminate congestion on Taxiway B. (Complete — $625,679)	Eases congestion. Decreases air pollution because of less idling time.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
A4	South Terminal Apron Addition Extension of the apron to the South Terminal to provide aircraft parking and circulation area to accommodate Boarding Area A. (Complete – $880,963)	Provides facilities for larger and quieter aircraft.
A5	Boarding Area A Apron Reconstruction of the apron around Boarding Area A, because of the new location and design of the structure, to provide adequate pavement and drainage. (Complete – $589,731)	No significant impact.
A6	Taxiway D, E, F, and G Lighting Installation of taxiway centerline lighting in accordance with new criteria established by the FAA. (Complete – $225,182)	Increased safety.
A7	Centerline Taxiway B Lighting Installation of centerline lighting on the new Taxiway B in accordance with new FAA criteria. (Complete – $148,777)	Increased safety.
A8	Remote Transmitter Facility Relocation of the air-traffic control remote transmitters off Plot 40 to a new location at the north end of Taxiway P. (Complete – $103,990)	No significant impact.

LANDSIDE AREA PROJECTS – PHASE I

Landside Facilities

L1	Cargo Building No. 7 Construction of Cargo Building No. 7 to accommodate the	Improves visual effect over buildings that were demolished.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
L1 (Cont'd)	increasing demand for cargo space by the airlines and to provide replacement space for Cargo Building No. 1, demolished for construction of the North Terminal. (Complete — $386,880)	
L2	North Airport Fill Fill at the northern limit of airport land to provide approximately 60 acres of additional property for the expansion of cargo facilities and for airport facilities such as the airport water quality control plant. (Complete — $2,464,384)	No significant impact.
L3	West of Bayshore Fill Fill west of PG&E transmission lines on West of Bayshore property to begin preparing approximately 50 acres of airport land for construction of airport support facilities, such as airlines commissaries, rental car service, and parking. (Complete — $1,804,824)	Eliminates a low swampy area which was a potential mosquito breeding area.
Airport Service Facilities		
L8	West of Bayshore Power Substation Construction of a power substation, located west of Bayshore and south of the San Bruno interchange, to provide additional power for the airport and also to serve as a backup major power service to the main airport substation located adjacent to the airport entrance. (Complete — $357,079)	No significant impact.
L9	Sewage Treatment Plant Construction of a new 2.2 mgd secondary sewage treatment plant north of the seaplane	Provides increased capacity and improves effluent quality discharge.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
L9 (Cont'd)	harbor to meet new effluent quality standards and to prepare for the expansion of the airport. (Complete — $2,410,087)	
L10	Influent and Effluent Lines to Sewage Plant Extension of sewage pipelines to the new sewage plant and construction of a new effluent line to discharge offshore from the seaplane harbor. (Complete — $459,505)	Improves sewage treatment process.
L11	Utilities to Sewage Plant Provision of power, water, and telephone utilities to the new sewage treatment plant. (Complete — $232,715)	Improves sewage treatment process.

TERMINAL AREA PROJECTS — PHASE II

North Terminal Complex

T3	North Terminal Structure Completion of the North Terminal, including: • Extension of east end of basement under frontal gates between Frame 110 and 120 and column lines A. 3 and F; extension of basement at west end between Frames 91 and 90 and column lines E and F, and between Frames 90 and 86 and column lines A. 3 and F. • Construction of the complete superstructure from Frame 86 to Frame 120 including first level other than slab, second and third levels, canopy, and roof designed for parking, and	Will provide for larger aircraft, more passengers, and an aesthetically pleasing visual effect.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
T3 (Cont'd)	finishing all public use areas, including two Superstair Complexes, and completion of rental areas in accordance with Airport Tenant Policy. • Construction of two pedestrian bridges connecting Superstair Complexes to the garage, with structural provision for People Mover System. • Finishing of basement constructed in Project T2. • Finishing of two pedestrian tunnels (constructed in Project T37) connecting the Superstair Complexes to the garage. • Construction of service road on a structural slab beneath the frontal gate holding rooms along the full length of the North Terminal. • Construction of a sidewalk-canopy structure, with crawl space below lower sidewalk, from Frame 120 to the East Terminal Building. • Construction and finishing of the sidewalk structures along the upper and lower terminal roads along the main North Terminal building from Frame 86 to Frame 120. (Budget — $28,000,000)	
T4	Boarding Area H and I and Connector Construction of a second-level satellite boarding area with a mezzanine area and partially enclosed ground floor level, providing approximately 272,000 sq ft of enclosed area, finished in public use areas and completed in rental areas	Will provide for larger aircraft, more passengers, and an aesthetically pleasing visual effect.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
T4 (Cont'd)	in accordance with Airport Tenant Policy; including a 520-sq-ft-long second-level connector to the North Terminal with structural provisions for a People Mover System. (Budget — $19,100,000)	
T5	Boarding Area G and Connector Construction of a second-level satellite boarding area providing approximately 29,000 sq ft of enclosed space with public use areas finished, rental areas completed in accordance with Airport Tenant Policy, and utilities stubbed for ground-level facilities to be constructed by tenant; including a 400-ft-long, second-level connector for the North Terminal with structural provision for a People Mover System. (Budget — $4,300,000)	Will provide for larger aircraft, more passengers, and an aesthetically pleasing visual effect.

East Terminal Complex

T6	East Terminal Additions and Modifications Additions to and remodeling of the East Terminal Building, including: • Addition of frontal gates on field side to match new construction and minor remodeling of exterior. • Construction of pedestrian bridge connecting the East Terminal Superstair Complex with the Ground Transportation Complex, with structural provision for the People Mover System. • Create a Superstair Complex, including necessary structural alterations to receive the pedestrian bridge from the Ground Transportation Complex and provision for a People Mover Station.	May require some passenger inconveniences during remodeling.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
T6 (Cont'd)	• Remodeling of existing pedestrian tunnel to the Ground Transportation Complex. • General remodeling of first, second, and third levels to new terminal standards and Airport Lease Policy, but excluding any structural alterations for airline automated baggage handling equipment. • Demolition of existing control tower and necessary refinishing of areas disturbed. • Service road connection between northeast and southeast frontal gates. (Budget — $12,800,000)	
T7	Northeast Frontal Gates Construction of frontal gates between the East Terminal and the North Terminal consisting of second-level frontal gate holding rooms and concourse, with a service road beneath frontal gate holding rooms on a structural slab. (Budget — $2,500,000)	Will provide an improved visual effect.
T8	Southeast Frontal Gates Construction of frontal gates between the East Terminal and the South Terminal east addition, consisting of second-level frontal gate holding rooms and concourse, with a service road on a structural slab beneath frontal gate holding rooms. (Budget — $2,700,000)	Will provide an improved visual effect.
T9	Boarding Area E-F and Connector Construction of a second-level central concourse and two second-level satellite boarding areas, providing approximately 67,00 sq ft of enclosed space, with 100-ft-long	Will provide for larger and quieter aircraft and an improved visual effect.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
T9 (Cont'd)	connecting corridors between the boarding area and the main concourse, and a 400-ft-long, second-level connector to the East Terminal; including finish of public use areas, completion of rental areas in accordance with Airport Lease Policy, stubbing utilities to ground-level facilities to be constructed by tenants, and structural provisions for a People Mover System on the new connector. (Budget — $7,500,000)	
South Terminal Complex		
T11	South Terminal West Addition Extension of South Terminal building from the existing wall (Frame 280) westward to Frame 270, providing a Superstair Complex for Boarding Area A and an additional 63,000 sq ft of public use and rentable space for the international airlines and concessionaires. Project includes: • Construction of full basement from grid lines B to F, a ground, second, and third level, a canopy and a roof designed as a parking area but not finished, with public use areas finished and rental areas completed in accordance with Airport Leasing Policy. • Construction of a pedestrian bridge connecting Boarding Area A Superstair Complex with the Ground Transportation Center, with structural provisions for the People Mover System. • Completion of the pedestrian tunnel (constructed in Project T37) connecting the above Superstair Complex to the Ground Transportation Center.	Will provide an improved visual effect.

	PROJECT DESCRIPTION	ENVIRONMENTAL IMPACT SYNOPSIS
T11 (Cont'd)	• Construction of sidewalk structure between terminal and terminal roads at upper and lower levels for the entire length of the extension. (Budget — $9,200,000)	
T12	South Terminal East Addition Extension of South Terminal building from existing east wall (Frame 321) eastward to Frame 327 to provide for Superstair Complex for Boarding Area D, including: • Construction of full basement, from grid lines B to F, ground, second, and third levels, canopy and roof designed as parking area, with public use areas finished and rental areas completed in accordance with Airport Lease Policy. • Construction of a pedestrian bridge connecting the Boarding Area D Superstair Complex with the Ground Transportation Center, with structural provision for the People Mover System. • Completion of the pedestrian tunnel (constructed in Project T37) connecting the above Superstair Complex to the Ground Transportation Center. • Construction of a sidewalk-canopy structure with crawl space below lower sidewalk from Frame 327 to East Terminal building. • Making minor changes in South Terminal to accommodate connection of Superstair. • Construction of sidewalk structure and finish between terminal and terminal roads at upper and lower levels for the length of the extension. (Budget — $6,300,000)	Will provide an improved visual effect.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
T13	South Terminal Additions and Frontal Gates • Construction and finishing of basement, first, second, and third levels; and roof additions at west and east ends between column lines D and E, to Frames 280 and 321, respectively. • Construction of basement area between column lines D and F in Frames 310 to 321 and 291 and 280. • Construction and finishing of frontal gate holding rooms and frontal gates at second level between Frames 298 to 280 and Frames 303 to 321. • Construction of service road on a structural slab beneath the frontal gate holding rooms along the full length of the South Terminal. (Budget — $8,500,000)	Will provide an improved visual effect.
T14	South Terminal Modifications Remodeling of the interior of the South Terminal, including: • Construction and finishing of the Boarding Area B-C Superstair Complex, including necessary structural alterations to receive the pedestrian bridge from the Ground Transportation Center and provision for a People Mover System station. • Remodeling of the existing pedestrian tunnel to the garage structure. • Conversion of space vacated by steam plant to operations or rental areas.	May require some passenger inconveniences during remodeling.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
T14 (Cont'd)	• General remodeling of finish and mechanical and electrical work to new terminal standards and Airport Tenant Policy, but excluding any structural alterations necessary for airline automated baggage handling equipment. • Modification of facade to match North Terminal facade. (Budget — $10,700,000)	
T15	Connector A Construction and finish of a 480-ft-long second level connector from the South Terminal to Boarding Area A, including a separate international arrivals corridor and structural provisions for a People Mover System. (Budget — $2,300,000)	Will provide an improved visual effect for international travelers.
T16	Boarding Area B Construction of three-level building similar to Boarding Area A, plus a second-level concourse with frontal gates joining it to Connector B-C, all providing approximately 84,000 sq ft of enclosed space, with public use areas finished, rental areas completed in accordance with Airport Lease Policy, and utilities stubbed for ground-level facilities to be constructed by tenants. (Budget — $8,000,000)	Will provide facilities for larger and quieter aircraft.
T17	Connector B-C Construction and finishing of a 540-ft-long, second-level connector from the South Terminal to Boarding Area B-C, including structural provisions for a People Mover System and station. (Budget — $4,300,000)	No significant impact.

	PROJECT DESCRIPTION	ENVIRONMENTAL IMPACT SYNOPSIS
T18	Boarding Area D and Connector Construction of second-level satellite boarding area providing approximately 29,000 sq ft of enclosed space, with public use areas finished, rental areas completed in accordance with Airport Tenant Policy, and utilities stubbed for ground-level facilities to be constructed by tenants; including a 400-ft-long, second-level connector to the South Terminal, with structural provisions for a People Mover System. (Budget — \$4,600,000)	Will provide for larger and quieter aircraft.
Terminal Support Facilities		
T19	Central Heating and Cooling Plant Remove steam plant from the South Terminal and install in the new garage structure with sufficient boilers to provide high-temperature hot water to heat entire Terminal Complex. Locate with the water heating plant a new water chilling plant of sufficient capacity to provide chilled water to air conditioning heat exchangers in each terminal. (Budget — \$5,000,000)	No significant impact.
T20	Utility Distribution Installation of utility mains from central supply facilities to the Terminal Complex facilities. (Budget — \$1,000,000)	No significant impact.
T21	Interline Baggage Tunnel Provision of perimeter baggage/utility tunnel below first-level slab of garage addition and existing garage to permit passage of	Will provide means to reduce the number of baggage cart trams required on the apron.

	PROJECT DESCRIPTION	ENVIRONMENTAL IMPACT SYNOPSIS
T21 (Cont'd)	utility distribution mains from the central supply facilities and to provide for possible future installation of an interline baggage system. (Budget — $2,800,000)	
T22	People Mover System (Terminal) Purchase of the equipment for the horizontal elevator concept presently envisioned; installation of track and controls plus attendant escalators or vertical elevators required for the routes between the Terminal Buildings and the various Boarding Areas. (Budget — $7,800,000)	Will provide for more convenience to the traveling public.
T23	Terminal Furniture Allowance for furniture and furnishings for public use areas in all newly finished and remodeled terminal facilities. (Budget — $500,000)	Will provide more pleasing and comfortable public areas for passengers and visitors to the airport.
T24	Art Requirements An allowance to provide for work found necessary to comply with City Charter in regard to art enrichment. (Budget — $2,000,000)	Will provide an improved aesthetic effect.
T25	Demolition of Piers b, c, d, e, ff, and g Demolition of piers that are to be replaced by new construction in the Proposed Expansion Program. (Budget — $1,250,000)	Will provide an improved visual effect.
Ground Transportation Complex		
T27	Existing Garage — Modifications Implementation of necessary modifications to the existing garage structure to accommodate the	Will provide for improved passenger circulation.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
T27 (Cont'd)	addition of the new structure and to integrate the vertical transportation cores with the revised passenger transportation concept, including modifications of the existing foundations, demolition of the two existing vertical pedestrian transportation cores and replacement with three new stair and elevator cores, removal of existing automobile ramps, removal of existing exterior screen and replacement with balustrade facade to match new addition, and additional structural modifications as necessary to accommodate the remodeling, and the sixth-level Passenger Distribution Center additions. (Budget — $5,600,000)	
T28	Existing Garage — PMS Structure Provision of increased strength in the existing garage structure to permit installation of People Mover Systems and stations on the three radial lines serving the South Terminal and Boarding Areas B-C, Boarding Area D, and the East Terminal and Boarding Areas E-F. (Budget — $3,600,000)	May require some passenger inconvenience during construction.
T29	Garage Addition — Structure Construction of a five-level addition to the existing garage, increasing the parking capacity by about 4,300 to a total of 7,300 cars, including: • Construction of two automobile ramps for vertical circulation between all levels. • Creation of a 200-ft central open space with a landscaped plaza around the control tower column at the first level.	Will provide increased automobile capacity. Will have a small effect on internal vehicle traffic. Will have a visual effect because this is the structure directly ahead as an automobile passenger travels toward the terminal along the main entrance road.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
	• Installation of parking and traffic monitoring and control system to assure maximum utilization of parking facilities. • Construction of four vertical transportation cores. (Budget — $28,000,000)	
T30	Garage Addition — PMS Structure Provision of support structure in the garage addition for People Mover Systems and stations on the three radials serving the North Terminal and Boarding Area H-I, Boarding Area G, and Boarding Area A. (Budget — $500,000)	No significant impact.
T31	Passenger Distribution Center Construction at the sixth level of a Passenger Distribution Center structure including supports to facilitate access to the six radial access bridges to the various terminal buildings including finishing of all public areas and installation of PMS stations. (Budget — $8,100,000)	Will have a visual effect as automobile passengers travel toward the passenger terminal.
T32	Control Tower and Ring Construction of a nominal 200-ft-high column to support FAA-supplied control tower, plus concession space, observation platform, and FAA facilities located immediately beneath the control tower cab. (Budget — $3,800,000)	Will have a visual effect because this will become the tallest structure on the airport. Preliminary schematics indicate it will be aesthetically pleasing.
T33	Northest Court Parking Deck Provides for construction of temporary second-level parking structure in the present Northeast court, providing approximately 40,000 sq ft of parking space for short-term terminal parking. (Budget — $700,000)	Will make short-term parking convenient for airport visitors.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
T34	Southeast Court Parking Deck Provides an identical facility as in T33 except in Southeast Court. (Budget — $600,000)	Will make short-term parking convenient for airport visitors.
T35	Rental Car Facilities Construction of multilevel parking, service, and administrative facilities for car rental agencies; all located on present Parking Lot A on the south side of the entrance road, with administrative areas finished in accordance with Airport Tenant Policy. (Budget — $5,000,000)	Will have a visual effect because this structure is on the south side of the entrance road and will provide more convenience for visitors to the city.
Ground Transportation Support Facilities		
T38	Upper Loop Road Section Completion of the final segment of of the inner loop of the upper terminal roads across the west side of the Ground Transportation Center, including piling for the final link of the lower road structures beneath. (Budget — $900,000)	Will provide improved automobile circulation.
T39	BART Access Structural provisions in foundations of garage addition to permit future construction of BART line and station below first level. (Budget — $2,000,000)	Will aid substantially in reducing the airport passengers' dependence on the automobile.
T40	People Mover System (Garage) Purchase of the equipment for the horizontal elevator concept presently envisioned and installation of track and controls plus attendant moving walks, escalators, or vertical elevators required for the routes between the terminals and the Ground Transportation Center. (Budget — $14,500,000)	Will provide for more convenience to the traveling public.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
T41	Road Graphics Provision of all location and direction signs on entry and terminal roads. (Budget — $600,000)	Will provide an improved visual effect.
T42	Grading, Irrigation, and Planting Provides for beautification by selected planting of entrance and exit ways from Bayshore Freeway to and around terminal complex. (Budget — $850,000)	Will provide an improved visual effect.

AIRSIDE AREA PROJECTS — PHASE II

A9	Runway 1L — Extension Extension of Runway 1L approximately 750 ft at its south end to develop sufficient runway to accommodate larger aircraft on departure. (Budget — $230,000)	Will provide for more aircraft takeoffs over the Bay. Construction is to upgrade an existing taxiway to a runway. Runway threshold for landing on 1L will remain the same. Since some aircraft inadvertently use this taxiway as a part of the runway for takeoff, changing to a legal takeoff status is not considered a significant runway extension.
A10	Runway 19L Hi-Speed Exit Provision of a high-speed exit near the south end of Runway 19L to increase its landing acceptance rate and to eliminate interference with the instrument landing system caused by aircraft just landed. (Budget — $600,000)	Will decrease taxi time and air and noise pollution.
A11	Runway Drains 19R and 19L Provision of pump stations and discharge lines to pump drainage water from Runway 19R and 19L into the Bay, as for Project A14. (Budget — $500,000)	No significant impact.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
A12	Complete Runway 28R, including accompanying taxiway completion of Runway 28R by extending it approximately 2,500 ft to the east, to the same limit as Runway 28L, developing it for a Category 3A classification which will provide for the lowest landing weather minimums. (Budget — $2,900,000)	A separate impact statement has been filed on this project.
A13	Runway 28R — Hi-Speed Exit Provision of a high-speed exit taxiway from the extended Runway 28R to increase the runway landing acceptance rate. (Budget — $550,000)	Will decrease taxi time and air and noise pollution.
A14	Runway Drains 28R and 28L Provision of pump stations and discharge lines to pump drainage water from Runway 28R and 28L into the Bay, replacing the present gravity drainage system, which has proved inadequate during high tides. (Budget — $500,000)	No significant impact.
A15	Extended Taxiways A and B to 10R Extension of Taxiways A and B to the western limit of Runway 10R to improve taxiway circulation and permit use of full length of the runway. (Budget — $1,500,000)	No significant impact.
A16	North Terminal Aprons Provision of aprons for the new North Terminal building and Loading Facilities G, H, and I. (Budget — $4,000,000)	Will provide for larger and quieter aircraft.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
A17	East Terminal Aprons Reconstruction of the aprons along the Southeast, East, and Northeast Terminals to provide for the frontal gate positions and for the new Loading Facilities E and F. (Budget — $1,000,000)	Will provide for larger and quieter aircraft.
A18	South Terminal Aprons Reconstruction of the aprons along the South Terminal building to provide for the frontal gate positions and for the new Loading Facility D. (Budget — $1,000,000)	Will provide for larger and quieter aircraft.
A19	Boarding Area B Apron Reconstruction of the apron around new Loading Facility B to provide adequate pavement and drainage. (Budget — $2,120,000)	No significant effect.
A20	Noise Monitoring Program Perform the required initial noise study and provide the necessary noise monitoring system in areas adjacent to the airport in accordance with State Law. (Budget — $500,000)	Will define more precisely noise-impacted areas.

LANDSIDE AREA PROJECTS — PHASE II

Landside Facilities

L4	West of Bayshore Utilities and Roads Provision of utilities and roads necessary for the development of the property prepared as a result of the West of Bayshore Fill (Project L3). (Budget — $1,300,000)	No significant impact.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
L5	Seaplane Harbor Rough Fill Fill of the Seaplane Harbor to create property for cargo, airline maintenance, and airport operational requirements. (Budget — $10,000,000)	A separate impact statement is to be filed on this project, together with L6 because this involves filling a small portion of the Bay.
L6	Seaplane Harbor Roads and Utilities Provision of roads and utilities on the land created under Project L5 above to permit development of the property. (Budget — $2,500,000)	See Project L5.
L7	Relocation of Standard Oil Hangar Construction of a new hangar on Plot 18 adjacent to the Seaplane Harbor to be occupied by Standard Oil in trade for their current hangar adjacent to Cargo Building No. 7; and conversion of the existing hangar for cargo purposes to accommodate those displaced from demolished Cargo Buildings Nos. 2 and 3. (Budget — $900,000)	No significant impact
Airport Service Facilities		
L12	Stand-by Power, Sewage Plant Provision of a 500-kva stand-by power generation unit at the Sewage Treatment Plant with capacity to run the plant in the event of outage of the usual power supply and prevent bypassing; in conformance with Federal requirements. (Budget — $525,000)	Will provide safety features to ensure that sewage treatment plant operates during power failures.
L13	Deep Water Outfall, Sanitary Construction of an effluent link from the sewage plant to a deep-water sanitary outfall to be shared with the South San Francisco/San Bruno Sewage Treatment Plant, including the airport's share of the cost of the extension of their existing outfall to 5,000-ft lengths; in conformance with Federal requirements. (Budget — $500,000)	A separate impact statement has been filed on this project by the City of South San Francisco.

	PROJECT DESCRIPTION	ENVIRONMENTAL IMPACT SYNOPSIS
L14	Replace Present Sanitary Sewers Replacement of present sanitary sewers to increase capacity and to provide the greater pressure strength necessary to feed to influent line of the new sewage treatment plant. (Budget — $700,000)	Will provide for a more efficient sewage treatment process.
L15	Industrial Waste Plant Construction of a water treatment plant in the north airport fill area to treat industrial wastewater from aircraft washing bays, apron, and similar areas. Designed to produce an effluent meeting standards of the water quality control board. (Budget — $2,500,000)	Will improve the quality of wastewater entering the Bay.
L16	Industrial Waste — Force Mains Construction of pressure pipelines required to convey wastewater from catch basins to the industrial waste treatment plant. (Budget — $1,000,000)	See Project L15.
L17	Industrial Waste — Pump Station Construction of pump stations required to pump industrial waste from catch basins to the industrial waste treatment plant. (Budget — $500,000)	See Project L15.
L18	Administration Building Construction of a multistoried facility on Lot B, with exterior appearance matching Rental Car Facilities on opposite side of entrance road. Top floor for Airport Administration, other floors for employee parking, with option of Maintenance Facility on portion of bottom two floors. (Budget — $5,000,000)	Will have a visual effect because this structure is on the north side of the entrance road.

	PROJECT DESCRIPTION	ENVIRONMENTAL IMPACT SYNOPSIS
L19	Automatic Control Equipment Control systems for sensing and automatically reporting to a central control room conditions of security, fire control systems, communications systems, traffic, parking, vertical transportation systems, utility and environmental systems, noise abatement, and airfield and road lighting. Provides more efficient operations with less manpower. (Budget—$5,000,000)	No significant effect.
L20	Airport Maintenance Facility Consolidating maintenance facilities into a complete complex providing shops, control center, vehicle maintenance facility, centralized supply, corporation yard, lunchroom, washroom, and locker facilities with employee parking. (Budger—$1,500,000)	Will permit demolition of existing facilities and will improve visual appearance.
L21	Fire-Crash Building Expansion of No. 1 Crash House to accommodate additional equipment and manpower. (Budget—$500,000)	Is a required safety item. No significant impact.
L22	North Access Road Construction of a new road to service the new property created by the North Airport Fill (Project L2). (Budget—$230,000)	Will provide increased vehicular access.
L23	Increase Frontage Roads to Four Lanes Reconstruction of the frontage roads between Milbrae Avenue and San Bruno Avenue to increase capacity to four lanes throughout. (Budget — $2,500,000)	Will increase vehicular capacity.

PROJECT DESCRIPTION		ENVIRONMENTAL IMPACT SYNOPSIS
L24	Overpass to West of Bayshore Property Construction of an overpass to connect the West of Bayshore property directly with the main airport area, to be located just south of the Bayshore Airport interchange, and connecting to Road R-2 immediately south of Hilton Hotel. (To be financed and constructed by California Highway Commission.)	Will provide increased vehicular access.

APPENDIX B

SYNOPSIS OF PUBLIC HEARINGS CONDUCTED BY THE REGIONAL AIRPORT SYSTEM STUDY COMMITTEE

The purpose of these hearings was to receive from agencies and the public response to the technical material prepared to date, to allow additional information to be added to the record, and to receive an insight into opinions and concerns about present and future aviation development in the region.

The Regional Airport Systems Study Committee (RASSC) had originally scheduled three public hearings in the Bay Area — North, Central, and South Bay. In response to requests from San Francisco and Marin counties, two additional hearings were added. The following is a summary of these hearings:

Fairfield — November 15, 1971

Speakers included local city and county officials, and representatives from an airport, an airport land use commission, a public works department, an industrial development agency, Travis Air Force Base, and the State Department of Aeronautics. Approximately 80 people attended.

Most speakers favored development of northern Bay airports as part of a regional airport system because of land available and favorable location for handling growth. For Solano County, it was suggested that there would be a tolerance of airports because of the community's acceptance of Travis. A Travis/Meridian Airport was advocated, with civilian operations on a runway parallel to the existing runway and use of Travis' air traffic control tower. A representative of the Base Commander at Travis stated that although limited civilian use had begun, plans were that military use would not be phased out. Testimony also indicated opposition to any joint use that would interfere with the military mission.

Other suggestions to the RASSC were to consider general aviation needs and air freight and to hold an additional hearing at the recommendation stage of the study. No adverse environmental comments were received at this particular hearing.

Oakland — December 13, 1971

At this hearing, speakers included the Mayor of Oakland, a judge, and representatives from the California Public Utilities Commission, the President's Aviation Advisory Commission, California Department of Aeronautics, Port of Oakland, chambers of commerce/convention and tourism bureaus, citizens, industry groups, labor, League of Women Voters, conservation groups, an economic development agency, and a flower shipping company. There were approximately 100 attendees.

Many who testified advocated expansion of Oakland airport (and the corollary of using all airports to capacity), because such development would increase jobs, attract visitors, and improve service.

Others felt that demand should not automatically be met, that growth should should be restrained because of detrimental impact on environment, inflated population forecasts, and alternatives to growth, including increasing load factors, and improving ground transit and access.

A member of the President's Aviation Advisory Commission suggested that the RASSC consider the long-range needs of the aerospace transportation system, based on user demand, environmental impact, and economic impact on the nonflying public.

The Chairman of the California Public Utilities Commission recommended that use of the existing airports to capacity be encouraged (particularly San Jose and Oakland) and dispersal of services near the origin/destination

of passengers. The Civil Aeronautics Board should then consider the Study findings for allocating routes. He offered Commission interest and support in the evolution of the plan.

Recommendations from those who testified included: keep military bases separate, explore the use of STOL, have flight operations over water to reduce noise, include general aviation in the study, look at a total transportation system, hold another hearing before final recommendation, and provide for airport planning and implementation of study findings after the study is completed. There was negative response to filling the Bay, and to three proposed sites — Richmond, Site E near Alviso, and Buchanan Field, Concord.

San Jose — January 10, 1972

Nearly 300 people attended, with representatives giving testimony from Congressman Edwards, local mayors, city managers, and councilman, the Sierra Club, Save Our Valley Action Committee, chambers of commerce, League of Women Voters, a school district, airport committees, and industry, citizen, and conservation groups. Many individuals also spoke.

The opinion reiterated almost unanimously was opposition to Site E (Alviso-Fremont area), because of noise and air quality hazards, encroachment on the proposed National Wildlife Refuge Area and growth implications. Many speakers supported no further expansion of San Jose airport, while others recommended such expansion.

Several people again advised the Committee to integrate air travel with other modes of transportation; to revise population forecasts downward, to coordinate with the Metropolitan Transportation Commission; to hold another hearing after the recommendation was made; to consider a

regional airport away from urban areas, and to continue the study through an implementation phase.

There was great concern expressed over some implications of air travel/ airport development. It was felt that the needs of the air traveler should not take precedence over those of the rest of the population; that air travel demand was perhaps not as high a priority as other needs (e.g., housing); that there were serious medical effects due to noise and air pollution; and that citizens should exercise some control over the usage of airports. A question for the Committee to consider was who should control the number of flights — CAB, the airlines, the airport, or the passengers?

San Francisco — February 3, 1972

Speakers at this hearing represented the S.F. Airports Commission, Sierra Club, City of Alameda, League of Women Voters, S.F. Chamber of Commerce/Visitors and Convention Bureau, a community development corps, conservation groups, labor, Federal Aviation Administration, Air Transport Association, Bay Conservation and Development Commission, and San Francisco Planning and Urban Renewal Association. Approximately 200 people attended.

Opinion seemed to be divided between those speakers who favored expansion of all area airports (because of increased employment) to accommodate demand, and those who did not favor expansion, but instead higher load factors, fewer scheduled flights, revised forecasts, and dispersal of airports.

Recommendations were made to consider joint use of Hamilton, general aviation needs, long-term regional airport planning, distant new airport locations, converting military bases to recreation areas, coordination with MTC, and airports located near the origin and destination of passengers.

Again, the point was made to consider the majority of the public who do not fly.

Airport expansion involving Bay fill was opposed during testimony. The guideline stated by BCDC, the agency issuing permits for fill, is that if Bay fill is requested for airport expansion, the burden of proof is on the proponent.

San Rafael — February 18, 1972

Speakers were from San Benito, Marin, and Sonoma Counties, representing the Board of Supervisors of San Benito County, City of Hollister, Hollister Chamber of Commerce and Women's Club, City of Novato Planning Commission, Novato Neighborhood Planning Groups, two homeowners associations, Marin Alternative, and Sonoma County Airport.

Testimony from the Hollister area stated opposition to a regional airport in their community, because of the expansion it would bring to their rural area, severe air pollution potential, and earthquake hazards. Alternatives suggested were dispersal of services to small airports, and use of rapid transit.

Also considered was the joint civilian/military use of Hamilton Air Force Base. Most speakers opposed such use of Hamilton because it would seriously affect the noise and air pollution levels, property values, and rural nature of Marin County.

The Study Committee was requested to hold other public hearings prior to final adoption of a plan.

Many Marin citizens were concerned that impact of airports on their neighborhoods should be thoroughly evaluated before any recommendations

were made. An example of the community viewpoint was expressed by the representative of Marin Alternative: "Thank you, gentlemen for your professional views and studies. But in the final analysis it is we who want to determine the make-up of our communities and our regions."

APPENDIX C

Appendix C

QUESTIONNAIRE SURVEY RESULTS

To obtain the public's response to the development of airports in the area, the Association of Bay Area Governments (ABAG) distributed 30,000 copies of a newspaper, Aviation Future, containing a questionnaire in 1971 to:

Individuals	43%
Conservation/ecology groups	9%
League of Women Voters	9%
Chambers of Commerce	8%
Bay Area airports (13 airports)	13%
ABAG mailing lists	10%
Others	8%

Eight hundred and fifty-one people answered and returned the questionnaire contained in the newspaper, and also reprinted by Save Our Valley Action Committee, Novato Planning Committee, the Fremont Argus, and the Novato Advance. The questionnaire is shown on the following page. A summary of the responses is given in the following paragraphs.

It should be noted that the county of residence of the respondents did not provide a uniform sample of all communities in the Bay Area. A breakdown of the county of residence of respondents compared to population is as follows:

Wanted: Your Opinion

Your opinion can have influence even if you do not testify at the public hearings. Please help us reach the "best" recommendation for the Region by mailing us your completed questionnaire as soon as possible. Your written responses, in addition to answers to the following questions, are welcome.

UNUSABLE

1. In your opinion, should the Bay Area provide additional facilities in the future for air travel into and out of the Region?

27 — 305 (35%) Yes — 275 (22%) No — 244 (29%) I need to know more about the alternatives

2. What relative importance do you assign to the following (please rank from 1, most important to 5, least important).
   - ____ Air travel availability and quality
   - ____ Easy access to and from airports
   - ____ Financial benefits of airports
   - ____ Financial costs of airports
   - ____ Environmental effects of aviation

   (see below)

3. Would you vote for an airport development:

   If the development were in your part of the Region?

   11 — 242 (28%) Yes — 465 (55%) No — 133 (16%) Undecided

   If the development were in some other part of the Region?

   30 — 236 (28%) Yes — 288 (34%) No — 289 (34%) Undecided

4. As an airline passenger, how long a trip (in minutes) would be "reasonable" for you to travel to or from the airport?

   48 — 18 (2%) 10 — 129 (15%) 20 — 343 (40%) 30 — 170 (20%) 40 — 143 (17%) 50 or more

5. If flight schedules were the *same* at these airports, which airport would you choose?

from home		*from work*	*from home*		*from work*
(17%) 147	San Francisco	130 (15%)	(38%) 319	San Jose	250 (29%)
(35%) 295	Oakland	273 (32%)	(2%) 16	other	21 (2%)
			(*where*)		(*where*)

73-home
178-work

6. If access time and cost were about the same for automobiles and rapid transit, which would you choose?

   15 — 143 (17%) automobile — 652 (77%) rapid transit — 41 (5%) undecided

7. In what city do you live? ~~(see below)~~

   In what city do you work? "

8. How many airline flights have you taken *out* of the Bay Area in the last year?

   14 — 190 (22%) 0 — 265 (31%) 1–2 — 165 (19%) 3–4 — 217 (26%) 5 or more

9. Of the environmental issues listed below, how would you rank them in order of importance to you (from 1 most important to 6 least important)?

   (see below)
   - ____ air quality
   - ____ bay preservation
   - ____ noise
   - ____ plant life
   - ____ population level
   - ____ wild animal life

10. Please return to: Regional Airport Systems Study, Association of Bay Area Governments, Hotel Claremont, Berkeley, California 94705

County	Population (U.S. Census) 1970	Percent of Total Bay Area Population	Number of Responses to Questionnaire	Percent (by county) of Responses to Questionnaire
Alameda	1,073,000	23	213	25
Contra Costa	558,000	12	122	14
Marin	206,000	4	90	11
Napa	79,000	2	0	0
San Francisco	716,000	16	40	5
San Mateo	556,000	12	39	5
Santa Clara	1,065,000	23	323	38
Solano	170,000	4	8	1
Sonoma	205,000	4	8	1
TOTAL	4,628,000		851	

- Question 2 — What relative importance do you assign to the following (please rank from 1, most important to 5, least important).

	1	2	3	4	5	Unusable
Air travel availability and quality	191	216	174	129	89	52
Easy access to and from airports	119	214	215	152	100	51
Financial benefits of airports	22	63	168	201	333	64
Financial costs of airports	37	201	117	246	187	63
Environmental effects of aviation	486	97	113	48	74	33

- Question 5 — If flight schedules were the same at these airports, which airport would you choose?

Airport Preference from Home (No. of responses)	Airport	Airport Preference from Work (No. of responses)
295	Oakland	273
147	San Francisco	130
319	San Jose	250
5	Marin County	5
1	San Rafael	1
2	Contra Costa	1
1	Buchanan	1
2	Solano County	2
2	San Benito County	2
1	Mendocino County	-

Airport Preference from Home (No. of responses)	Airport	Airport Preference from Work (No. of responses)
1	Napa	1
1	Palo Alto	1
-	Fremont	1
-	Livermore	2
-	Walnut Creek	2
-	Hamilton	2
73	Unusable	178

- Question 9 — Of the environmental issues listed below, how would you rank them in order of importance to you (from 1, most important to 6, least important)?

	1	2	3	4	5	6	7	Unusable
Air quality	413	215	96	46	34	22	0	25
Bay preservation	105	172	195	187	92	68	2	30
Noise	163	182	164	97	89	136	0	20
Plant life	54	49	120	194	254	148	0	32
Population level	230	122	132	119	81	139	0	28
Wild animal life	56	64	85	139	219	254	0	34
Other	1	1	0	0	0	0	1	0

There are 157 additional comments, falling into the following categories: airport development (46), environment (43), access (22), other modes of transportation (10), questionnaire itself (8), RASS itself (6), improved airline service (5), personal relationship to aviation (7), and multiple comments (9).

COMMENTS AND COMPARISONS

- Questions 1 and 8 — providing additional facilities and number of flights in last year: Of the respondents who had flown one or more times out of the area, more favored additional facilities than did not. However, those who had not flown at all disapproved of additional facilities more often than they approved.

- Questions 3 and 8 — voting for nearby or distant airport development and number of flights: Most people responded that they did not favor either nearby or distant development, regardless of number of flights.

- Questions 4 and 6 — reasonable travel time and preference between automobile and rapid transit: The travel time chosen most often as reasonable by those who preferred either the automobile or rapid transit was 30 minutes.

  The travel times were ranked as follows:

  - Automobile: 30 minutes first, then 20, 40, 50, and 10 minutes
  - Rapid transit: 30 minutes first, then 40, 50, 20, and 10 minutes

- Questions 4 and 8 — reasonable travel time and frequency of flight: Whatever the frequency of flight, the preferred travel time was 30 minutes.

- Questions 1 and 3 — provide additional facilities and nearby/distant airport development: Of the responses possible, more responded "no" to providing facilities and "no" to voting for development — either nearby or distant.

  Desire for facilities and willingness to vote for airport development are correlated. The most frequent response was yes facilities/yes development.

- Questions 1 and 7a — providing facilities and county of residence: Of responses from Alameda, San Mateo, Santa Clara, and Sonoma Counties, more responded "no" to additional facilities than responded "yes." The reverse was true for Contra Costa, Marin, San Francisco, and Solano County respondents; more responded "yes" to additional facilities.

- Questions 5 and 8 — airport choices from home and work and number of flights (OAK=Oakland, SFO=San Francisco, SJC=San Jose).

  From home

  Those who have flown 3-4, or more than 5 times chose OAK, then SJC, then SFO. Those who have flown 0 or 1-2 times chose OAK, then SJC, then SFO.

  From work

  Those who have flown 0, 1-2, or 3-4 times chose OAK, then SJC, then SFO. Those who have flown more than 5 times chose SJC, then OAK, then SFO.

- Questions 5 and 7 — home and work airport choice, and county of residence and employment: Airport choices

from home and work when compared with county of residence and employment were so similar that they followed this pattern with only minor discrepancies;

County	Airport Choice (listed in order of ranking)
Alameda	OAK, SJC, SFO
Contra Costa	OAK, SFO, SJC
Marin	SFO, OAK
Napa	No response to questionnaire
San Francisco	SFO, OAK, SJC
San Mateo	SFO, SJC, OAK
Santa Clara	SJC, SFO, OAK
Solano	OAK, SFO
Sonoma	OAK, SFO

- Questions 6 and 8 — choice of automobile and rapid transit and frequency of flights: Of the people who chose rapid transit, the greatest number of responses came from those who had flown 1-2 times in the past year, while of those who chose automobiles, the greatest number of responses came from those who had flown more than 5 times. However, whatever the flight frequency, more people chose rapid transit than chose the automobile.

- Questions 7 and 8 — county of residence/employment and frequency of flight: The counties with a large sample — Alameda, Santa Clara, and Contra Costa — all followed this pattern of flight frequency; 1-2 flights/year most frequent, then more than 5, then 0, then 3-4 flights. (This applies to both county of residence and county of employment.)

- Compare the home and work airport choices stated in question 5 with the consultant work on Access done by Wilbur Smith, Phase I, June, 1970: (Airport Access).

  The Access report shows that for 1975, assuming unconstrained conditions, air passengers would be allocated as follows:

SFO	33%
OAK	44%
SJC	23%

The results of this questionnaire show that, of those who responded (note that there is a low response rate from Napa, San Francisco, San Mateo, Solano, and Sonoma Counties), and with unrestrained conditions, their choice of airports in 1972 would be as follows:

From Home		From Work	
SFO	17%	SFO	15%
OAK	35%	OAK	32%
SJC	38%	SJC	29%

SOURCES
BOLT BERANEK NEWMAN
ABAG

SAN FRANCISCO INTERNATIONAL AIRPORT

ENVIRONMENTAL IMPACT REPORT FIGURE 2-2

SAN FRANCISCO INTERNATIONAL AIRPORT

ENVIRONMENTAL IMPACT REPORT FIGURE 2-3

SOURCES
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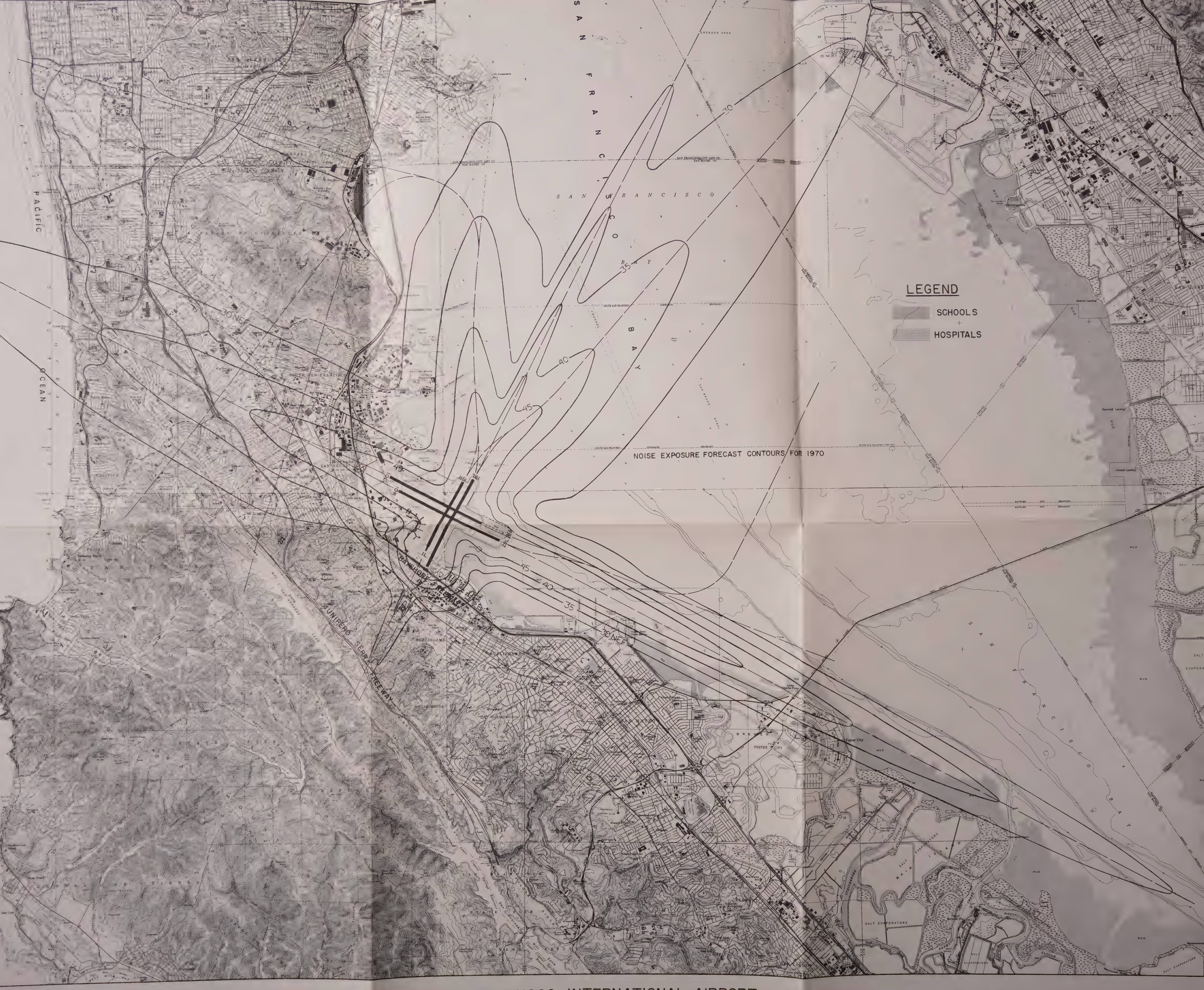

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ENVIRONMENTAL IMPACT REPORT FIGURE 2-4

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ENVIRONMENTAL IMPACT REPORT FIGURE 2-5

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SAN FRANCISCO INTERNATIONAL AIRPORT
ENVIRONMENTAL IMPACT REPORT FIGURE 2-7


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